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Transtheoretical Model and Exercise in Breast Cancer Survivors

by

Todd M. Bobick ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfilment
of the requirements for the degree of Masters of Science

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Dedication

I would like to dedicate this research to the survivors of cancer who I have had the pleasure of working with during my studies.

Abstract

Recent research suggests that quality of life is positively correlated with frequency of exercise in cancer survivors. Given this finding, a premier empirical study then used a validated theoretical model of health behavior change, the theory of planned behavior (TPB), to better understand exercise motivation in breast cancer survivors. However, another well-validated framework, the transtheoretical model (TTM), had yet to be applied to breast cancer survivors. It offers practical advantages over the TPB, such as including techniques and strategies that can be used to assist in progress towards, or maintenance of, regular exercise. The present study's purpose was to apply the TTM to the understanding of exercise motivation in breast cancer survivors and to evaluate whether it effectively described the relationship between the measured variables. Findings suggest that, with the exception of dramatic relief, all TTM variables reliably distinguished at least one stage from another. However, often complex hypotheses stating the relation of individual variables to stage of change were only partially supported, and effect sizes were generally moderate to small. Hence, only weak support for the TTM as a useful model of exercise behavior change in breast cancer survivors was suggested. However, it is proposed that important information on exercise motivation is gained by conceptualizing exercise in terms of a progression in stages, as opposed to simply an active or inactive dichotomy. Practically, it is suggested that future research focus on alternate stage models of exercise behavior change in the understanding of exercise behaviors for breast cancer survivors.

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Chapter 1

With present day advances in medical and drug technologies, cancer survivors typically live for considerable periods of time after the completion of treatment. In Canada, it was estimated that 130,000 individuals would be diagnosed with cancer in 1998 (National Cancer Institute of Canada, 1997). Further, in the United States the National Cancer Institute estimates that presently over 8 million individuals are alive that have had cancer at some point in their lives (American Cancer Society, 1998). The vast numbers of cancer survivors in North America, increasing trends in cure rates, and a lengthening of survival times, all indicate the importance of studying quality of life (QOL) issues in cancer survivors. These issues will require greater emphasis if cancer survivors are to most effectively cope with the cancer experience and return to, or surpass, their prediagnosis QOL levels.

Many psychosocial intervention therapies such as social support, counselling, biofeedback and psychotherapy are available to assist patients with cancer in coping with treatment and in recovering from disease (Anderson, 1992; Meyer & Mark, 1995). Most of these interventions focus on psychological issues, with little attempt to address the physical and functional problems that these cancer survivors typically encounter (Courneya & Friedenreich, 1997b, 1997c). This view may be incomplete considering that physical and functional well-being are essential elements in overall ratings of QOL (Cella & Tulsky, 1990). Physical exercise is one intervention strategy that has recently received increased attention in the literature. Recent empirical reviews have suggested that exercise may offer numerous advantages for QOL outcomes during and after cancer treatment including physical, functional, social, and emotional well-being (Courneya & Friedenreich, in press; Smith, 1996).

In a recent review, Courneya and Friedenreich (in press) reviewed 13 studies that evaluated exercise and QOL outcomes following breast cancer diagnosis (see Appendix A for expanded QOL empirical review). This body of research has consistently revealed that exercise is related to improvements in functional capacity, both during and after treatment, when compared to non-exercising breast cancer patients. Further, these gains have also been shown to parallel those of healthy controls on a similar program. Exercising breast cancer patients also showed greater self-esteem, more physical competence, greater internal locus of control, decreased nausea during treatment, less fatigue, anxiety and sleep problems, lesser mood disturbance, decreased body fat and increased lean body mass, and better psycho-social adjustment and fewer overall symptoms during treatment. Exercisers also revealed higher overall QOL ratings and greater overall satisfaction with life than those of non-exercisers. Further, individuals who maintained exercise from prediagnosis, through active treatment and beyond, reported the highest QOL and satisfaction with life.

Because exercise holds many advantages for breast cancer survivors, we must now address issues related to its initiation and maintenance. Regrettably, the exercise patterns of patients with cancer reveal an overall decrease in strenuous and total levels of exercise from the period before diagnosis to after treatment has ended (Courneya, Friedenreich, Arthur, & Bobick, 1999b; Courneya & Friedenreich, 1997b, 1997c; Cooper, 1995; Keats & Courneya, in press). These findings raise concern about possible negative effects of reduced activity in breast cancer survivors.

Statement of the Problem

Research has shown that despite the health benefits of exercise, problems with motivation and adherence are common (Dishman, 1988). It has been shown that 50% of individuals who initiate an exercise program drop out during the first three to six months. This lack of adherence is common regardless of the population or purpose of the exercise. With such low prevalence and high drop-out rates, a theory to help explain exercise behaviors with an application to practical interventions is needed.

The psycho-social determinants of exercise behavior are best studied using validated theoretical models (Dishman, 1988, 1994). These models allow for the identification of a limited number of previously validated psycho-social variables and further describes their hypothesized interrelationships. This approach provides the basis for intervention design in the promotion of exercise specific to different populations. Only eight studies have examined psycho-social determinants in cancer samples (see Appendix B for empirical study summaries; see Appendix C for an empirical study summary table).

Only Courneya and Friedenreich (1997a, 1999) and Courneya et al. (1999b) have used a validated theoretical model, the theory of planned behavior (TPB; Ajzen, 1991), to assess exercise determinants. These studies include Courneya and Friedenreich's (1997a) cross-sectional and Courneya et al.'s (1999b) prospective study of colorectal cancer patients, and Courneya and Friedenreich's (1999) cross-sectional study of a breast cancer survivor sample. This body of research provides initial support for the TPB as a useful framework for understanding exercise determinants in cancer survivors.

The TPB is a model that makes predictions about which individuals are, or will be, active or inactive at a specific moment (Courneya, Nigg, & Estabrooks, 1998). However, it has been hypothesized that individuals progress through numerous stages of exercise behavior change suggesting that unique determinants, and thus specific interventions may be required for each stage of acquiring or maintaining exercise behaviors (Dishman, 1991; Sallis & Hovell, 1990; Sonstroem, 1988).

Transtheoretical Model

The best-validated stage framework for understanding the determinants of exercise behavior is the transtheoretical model (TTM; Prochaska 1979, 1984; Prochaska & DiClemente, 1982). The model includes constructs from numerous therapy models including behaviorism, psychoanalysis, existentialism, gestalt therapy, client-centered, Adlerian therapy, rational-emotive therapy, emotional flooding, transactional analysis, and systems therapies, in an attempt to understand health behavior change. The underlying principles and mechanisms of transtheoretical therapy were then used to construct the TTM of behavior change (Prochaska & DiClemente, 1982).

The original TTM began with the stages of change and the processes of change constructs (Prochaska, 1979, 1984; Prochaska & DiClemente, 1982). The model then added self-efficacy and decisional balance (i.e., pros and cons) elements (DiClemente et al., 1991). The model suggests that health behavior change occurs in an understandable pattern (Prochaska, DiClemente, & Norcross, 1992). With the TTM's success in explaining the cessation of negative health behaviors such as smoking (e.g., Prochaska, Velicer, DiClemente, & Fava, 1990), it was promptly adapted to understand positive health behaviors initiation, including weight loss (e.g., O'Connell & Velicer, 1988), and exercise (e.g., Marcus, Selby, et al., 1992).

Stage of change is the core construct of the TTM as it reflects a temporal dimension in which health behavior change takes place. Stages are considered intermediate to traits and states. Traits are considered stable and resistant to change, and states are readily changed but lack stability (Marcus & Simkin, 1994). Movement through these stages has shown to be both linear and cyclical. The amount of time an individual spends at each stage does vary, but the stages are invariant (Prochaska, DiClemente, et al., 1992). Also, an individual can potentially make many attempts at behavior change before ever reaching the final stage (Prochaska, DiClemente, & Norcross, 1992). However, those who do regress to earlier stages learn from their previous attempts and may be in a better position to attempt subsequent behavior change (DiClemente et al., 1991). The stages of change have been labelled as follows:

1. Precontemplation is defined as no intention to change, or denial of the need to change (Marcus, Selby, et al., 1992). These individuals are often uninformed or demoralized about their ability, and are resistant to considering a change. Social pressures may even make these individuals defensive about a need to change (Prochaska & Marcus, 1993). These individuals may wish to change, but this is very different in a practical sense from a serious consideration of change (Prochaska, DiClemente, et al., 1992).

2. Contemplation is defined as seriously considering a change (Marcus, Selby, et al., 1992). The concept of intention to change is the central defining element of this stage

(Prochaska, DiClemente, et al., 1992). Contemplators are ambivalent about behavior change due to viewing the pros and cons of the at-risk behavior as approximately equal (Prochaska & Marcus, 1993).

3. Preparation is defined as making small changes (Marcus, Selby, et al., 1992). These individuals have a plan, and will have initiated some behavior changes, but not yet to a pre-set criteria. Preparation is the first stage to combine both intentional and behavioral elements (Prochaska, DiClemente, et al., 1992). This stage is not very stable and individuals are more likely to progress than those in precontemplation and contemplation stages.

4. Action is defined as being actively engaged in changing the behavior (Marcus, Selby, et al., 1992), but having reached the criterion only within the last six months (Prochaska & DiClemente, 1983). This stage is the least stable and has the highest risk of relapse (Prochaska & Marcus, 1993).

5. Maintenance is defined as a continuation of the behavior change over time (Marcus, Selby, et al., 1992). The individual is working to prevent relapse and to consolidate gains attained during the action stage (Prochaska, DiClemente, et al., 1992). Termination, which is the last stage identified for addictive behaviors, may not exist for exercise behavior (Prochaska & Marcus, 1994; Cardinal, Engels, & Zhu, 1998; Cardinal, 1995b). This stage is reached when the risk of returning to the previous unhealthy behavior has been completely terminated (i.e., the risk is zero), and is so well established that no additional time or effort is needed to sustain it (Prochaska, 1995; Prochaska & DiClemente, 1982, 1984; Prochaska & Marcus, 1994). Applying these criteria,

researchers have failed to find support for the existence of a termination stage in the exercise domain (Courneya & Bobick, 1998).

Prochaska and DiClemente (1983) state that there are 10 basic processes used by individuals to modify their behavior. The processes are consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, social liberation, self-liberation, reinforcement management, counterconditioning, stimulus control, and helping relationships. See Table 1 - 1 for definitions of the individual processes. The processes of change can be further dichotomized into two higher-order constructs: (a) cognitive and (b) behavioral processes (Prochaska, 1979). Generally, behavioral processes involve external-behavioral actions taken to modify the target behavior (e.g., stimulus control), while cognitive processes involve internal-cognitive actions (e.g., self-reevaluation). The TTM also includes a self-efficacy construct, which is defined as a person's belief that he or she can accomplish a particular goal (Bandura, 1977). Self-efficacy is thought to be an important predictor of stage membership, especially in the action and maintenance stages (Prochaska & Marcus, 1994).

Further, the TTM includes the concept of decisional balance, which is based on the model of decision making by Janis and Mann (1968). Pros (i.e., benefits) and cons (i.e., costs) are thought to be relevant in understanding and predicting transitions between the precontemplation, contemplation, and preparation stages, while being of lesser importance in action and maintenance (DiClemente et al., 1991). In the preparation stage, pros and cons are thought to intersect or crossover (Marcus, Rakowski, & Rossi, 1992).

Table 1 - 1

Definitions of the Processes of Change

Process	Definition
Consciousness Raising	Efforts by the individual to seek new information and to gain understanding and feedback about the problem behavior.
Counterconditioning	Substitution of alternative behaviors for the problem behavior.
Dramatic Relief	Affective aspects of change, often involving intense emotional experiences related to the problem behavior.
Environmental Reevaluation	Consideration and assessment of how the problem effects the physical and social environments.
Helping Relationships	Trusting, accepting and utilizing the support of caring others during attempts to change behaviors.
Reinforcement Management	Changing the contingencies that control or maintain the problem behavior.
Self-Liberation	The individual's choice and commitment to change the problem behavior, including the belief that one can change.
Self-Reevaluation	Emotional and cognitive reappraisal of values by the individual with respect to the problem behavior.
Social Liberation	Awareness, availability and acceptance by the individual of alternative, problem-free lifestyles in society.
Stimulus Control	Control of situations and other causes which trigger the problem behavior.

(Marcus, Rossi, Selby, Niaura, & Abrams, 1992, p. 387; Marcus, Banspach, et al., 1992, p. 425).

Courneya et al. (1998) conceptualize the process of change constructs as an attempt to explain how people make behavioral changes. Self-efficacy and decisional balance variables help understand the cognitive aspects of this change, and are thus termed the why of health behavior change. Lastly, stage of change constructs define when meaningful change has occurred.

A total of 46 TTM articles have evaluated exercise behavior in numerous population samples (see Appendix D for individual empirical study summaries; see Appendix E for an empirical study summary table). The stage of change construct of the TTM has been consistently supported in the exercise domain across numerous samples including differing worksite groups (e.g., government; Herrick, Stone, & Mettler, 1997), ages (e.g., preadolescents; Cardinal et al., 1998), residence locations (rural, urban and metropolitan; Potvin, Gauvin, & Nguyen, 1997), sexes (e.g., female; Marcus, Pinto, Simkin, Audrain, & Taylor, 1994), medical conditions (e.g., cardiac; Hellman, 1997), and cultures (e.g., Australian; Booth et al., 1993).

Additionally, self-efficacy has been supported as an important determinant of exercise behavior change (e.g., Armstrong, Sallis, Hovell, & Hofstetter, 1993). Further, findings suggest individual stages of change can be distinguished by decisional balance indices (e.g., Clarke & Eves, 1997). Also, studies have shown that subjects in different stages utilize the processes of change in significantly different ways (e.g., Gorely & Gordon, 1995), however, this aspect of the TTM remains the least researched. Furthermore, longitudinal assessments of TTM constructs have supported a predictive relationship to exercise stage of change over time (e.g., Armstrong et al., 1993). Lastly, studies (e.g., Marcus et al., 1998) have supported the effectiveness of TTM stage-matched interventions in the promotion of exercise.

However, no study has evaluated the TTM and exercise specific to breast cancer survivors, or among cancer survivors in general. Typically, TTM research has focussed on healthy, middle-class, middle-aged men and women. The breast cancer population differs from those previously researched in that it is composed of middle-to older-aged women from all classes who have experienced the unique psychological and physical issues that are associated with cancer diagnosis, treatment, and recovery. This unique profile suggests that this population significantly differs from any in which the TTM has been applied before, and as such provides rationale for its application to breast cancer survivors.

Further, evidence exists that differing beliefs underlie the exercise behaviors in different cancer populations. This has been demonstrated by an application of the TPB to breast cancer (Courneya & Friedenreich, 1999) and colorectal cancer survivor samples (Courneya & Friedenreich, 1997a; Courneya et al., 1999b). The TPB allows for the evaluation of specific beliefs which are hypothesized to underlie its theoretical constructs. Intention and perceived behavioral control were found to be important predictors of exercise in all studies. However, Courneya and Friedenreich's (1999) breast cancer sample revealed both attitude and subjective norm to be significant predictors of intention to exercise, while Courneya and Friedenreich's (1997a; Courneya et al. 1999b) colorectal cancer samples indicated that only attitude was significant. This difference in exercise determinants supports the tenet that the underlying beliefs about exercise may be different, meaning that certain variables may be more or less important in predicting exercise behavior for different cancer populations. This difference lends further support for the necessity of conducting exercise determinant research in cancer survivor populations.

Purpose and Hypotheses

The purpose of the present study was to apply the TTM as a framework for understanding exercise behavior in breast cancer survivors after the completion of their treatment. The general hypotheses, based on the TTM (Prochaska 1979, 1984; Prochaska & DiClemente, 1982) and empirical research in the exercise domain, were that self-efficacy, decisional balance and processes of change measures would be unique and distinguishable between the five stages of change.

It was hypothesised that:

1. Breast cancer survivors would have regressed to lower stages of exercise change from the prediagnosis to active treatment time periods. However, stage would advance in the posttreatment time period, but would not return to that occupied at prediagnosis. These hypotheses are based on self-report exercise frequency levels noted in previous exercise and cancer literature (Courneya et al., 1999b; Courneya & Friedenreich, 1997b, 1997c; Cooper, 1995; Keats, in press).

2. Cognitive process of change use would increase from precontemplation to contemplation, and then again from preparation to action. The use of these processes would stay the same between contemplation and preparation, and decrease from action to maintenance.

3. Behavioral process of change use would increase from precontemplation through action, and then remain the same through maintenance.

4. Self-efficacy would increase linearly from precontemplation through maintenance.

5. Pros would increase in a linear fashion from precontemplation through maintenance.

6. Cons would decrease in a linear fashion from precontemplation through maintenance. Further, the decisional balance index (i.e., pros minus cons) would reveal a negative value in the precontemplation and contemplation stages, and a positive difference in the action and maintenance stages. The pro-con crossover (i.e., where pros and cons mean values are equal) would occur in the preparation stage using standardized T-scores (i.e. M = 50; SD = 10), and in precontemplation using raw scores.

Lastly, the theoretical notion of a structured interrelationship existing among the TTM variables put forth by Courneya et al. (1998), was tested. It suggests that the TTM's social-cognitive variable (i.e., self-efficacy, pros, and cons) mediate the relationship between the processes and stages of change.

Chapter 2

Method

Participants

A sample of non-metastatic breast cancer survivors diagnosed between September 1995 and December 1997, who had completed both surgery and adjuvant therapy, were recruited. Adjuvant therapy was defined as either chemotherapy or radiotherapy, or a combination of the two, that followed surgery to treat cancer. Hormone therapy agents (e.g., Tamoxifen) for the long-term treatment of breast cancer were not considered as adjuvant therapy for the purpose of this study. Exclusion criteria included breast cancer survivors above 70 years of age. The sample's age range was limited because the focus of the study is rehabilitory, and subsequent interventions will most likely be focussed on those most physically able to exercise.

Only those whose cancer staging information was complete were chosen from the initial 1385 individuals identified through the Alberta Cancer Registry. This was done to ensure the completeness of the data for the final sample, and subsequently yielded 389 individuals. Next, each individual's corresponding physician was contacted in an effort to gain his or her consent to send the study's questionnaire mail-out. For the potential participants, 322 received and 13 did not receive their physician's approval. The physicians for 54 potential participants could not be contacted. For those individuals who received non-approvals, 5 reasons were not available, 2 individuals were deceased, 2 had a breast cancer recurrence, 1 had clinical anxiety, 1 held a very negative attitude, 1 had metastatic disease, and 1 was an alcoholic.

Subsequently, a total of 322 questionnaire packages were mailed, of which 312 were successfully delivered and 10 were not because of an incorrect address. The return rate was 58.3%, with a total of 182 questionnaires completed (4 not included in the analyses because they were returned late). Of those who reported reasons for refusing to participate, 1 had study ethical concerns, 1 had metastatic disease, 1 had a recent surgery, and 1 was not interested. The final sample size available for the analyses was 178.

Design and Procedure

The study used a retrospective stage of change assessment in which participants were asked to recall their stage at prediagnosis, during treatment, and posttreatment time periods. Additionally, the TTM variables (i.e., stage of change, ~~pros, cons,~~ decisional balance, self-efficacy and processes of change) were assessed cross-sectionally. Recruitment began with the physicians of potential participants being contacted by mail (see Appendix F) and telephone. Those potential participants who received physician approval were mailed a self-administered questionnaire package that included an introductory letter (see Appendix G), two copies of an informed consent (see Appendix H), questionnaires, and a self-addressed stamped envelope. Participants were asked to complete and return one copy of the informed consent along with the questionnaires at their earliest convenience. Features that have been shown to increase response rates (Ransdell, 1996) were utilized such as including postcard reminders, stamped return envelopes, personalized cover letters, colored paper, assurance of confidentiality, and university endorsement. The mail protocol was based on a modified version of the Total Design Method (Dillman, 1983) utilized in Courneya and Friedenreich (1997a, 1997b, 1997c, 1999). This included: (a) an initial mailing of the questionnaire package, (b) mailing a postcard reminder (see Appendix I) one week later, and (c) mailing a second questionnaire package three weeks later to those who did not respond to the first mailing or the postcard reminder.

Instruments

Background information.

The demographic-medical questionnaire contained questions regarding age, marital status, education, annual family income, employment status, duration of treatment, surgery type, as well as height and weight information, which was subsequently used to calculate body mass index (BMI; Hannan, Wrate, Cowen & Freeman, 1995). See Appendix J for the demographic-medical questionnaire. Other medical data (i.e., diagnosis date, disease stage, and adjuvant therapy type) was gained through the Alberta Cancer Registry.

Exercise stage of change questionnaire.

The exercise stage of change questionnaire was an adaptation from the original smoking stage of change questionnaire (Prochaska & DiClemente, 1983, 1985; DiClemente et al., 1991) designed to apply to the exercise domain (Marcus, Selby, Niaura, & Rossi, 1992). Over a two-week period, the kappa index of reliability was .78 (Marcus, Selby, et al., 1992). The exercise stage of change measure has shown to be associated with both self-report behavior (Hellman, 1997; Wyse, Mercer, Ashford, Buxton, & Gleeson, 1995; Pinto & Marcus, 1995; Marcus & Simkin, 1993; Murphy, 1993) and objective measures of fitness (Cardinal, 1997b; Wyse et al., 1995; Murphy, 1993).

In the present study, a modified stage of change questionnaire (Courneya, 1995b) was further refined to assess stage membership at the prediagnosis, during treatment, and posttreatment time periods (see Appendix K). Participants were asked to indicate the statement that best represented their exercise pattern at that time, this subsequently classified the individual into one of the five stages of change.

Processes of change questionnaire.

The processes of change questionnaire (Marcus et al., 1992) assessed the pattern of process of change use for the individual stages of change (see Appendix L). It utilizes a five-point Likert scale ranging from 0 (strongly disagree) to 5 (strongly agree). As a cross-validation (Marcus, Rossi, et al., 1992), all 10 process of change questionnaire scales were also correlated with Cohen and Williamson's (1987) perceived stress measure, as well as the demographic variables of sex, age, race, education, income, BMI, and smoking status. The median value of the 80 correlation coefficients was .07, and no correlation exceeded ±.25. Further, additional validation was provided by the similarity between the two independent samples used in the study. The processes of change questionnaire has been shown to be significantly related to the stage of change construct (e.g., Buxton, Wyse, & Mercer, 1996; Cardinal, 1995b; Marcus & Simkin, 1994; Prochaska & Marcus, 1994). In the present study, internal consistencies for the individual process of change constructs were consciousness raising ($\alpha = .84$), counterconditioning ($\alpha = .76$), dramatic relief ($\alpha = .94$), environmental reevaluation ($\alpha = .80$), helping relationships ($\alpha = .85$), reinforcement management ($\alpha = .77$), self-liberation (α = .83), self-reevaluation (α = .87), social liberation (α = .74), and stimulus control (α = .72).

Self-efficacy questionnaire.

The Marcus, Selby, et al. (1992) questionnaire measures exercise self-efficacy using an 11-point Likert scale ranging from 0 (not at all confident) to 10 (very confident). Internal consistency (Cronbach's alpha) for the present studies modified self-efficacy scale was .91. The self-efficacy measure has been shown to be significantly related to the exercise stage of change construct (e.g., Cardinal, 1995b; Marcus & Simkin, 1994; Prochaska & Marcus, 1994).

The Marcus, Selby, et al. (1992) questionnaire was originally developed for a middle-aged working population, but has also been validated in both older (e.g., Gorely & Gordon, 1995) and clinical (e.g., cardiac older adults; Hellman, 1997) adults. Gorely and Gordon (1995) found that the self-efficacy measure revealed the theoretically predicted linear increase from the precontemplation through maintenance stage of change. In addition, Hellman (1997) found that the self-efficacy measure differentiated the stages of change in older adults with a cardiac diagnosis. Since the measure has been validated in both healthy and medical populations, and the mean age of the current study's participants would be similar to both Hellman (1997) and Gorely and Gordon (1995) samples, a modified Marcus, Selby, et al. (1992) self-efficacy measure was considered appropriate for this study.

Self-efficacy refers to one's confidence in their ability to overcome specific barriers to behavior (Bandura, 1977). As it is specific to both situation and behavior, modifications to the original self-efficacy measure were made as to ensure its relevance to this sample. Through a literature search on exercise in breast cancer survivors, the following additional items were added:

1. "I am confident I can exercise regularly without injuring myself." Confidence in the ability to avoid injury while exercising was identified through interview research (Leddy, 1997), and was found to differentiate exercising and non-exercising breast cancer survivors (Perna, Spencer, Carver, Antoni, & LaPerriere, 1997).
2. "I am confident I can exercise regularly even when I have been inactive for a period." Leddy (1997) reported the issue of inertia in 27% of interview participants.
3. "I am confident I can exercise regularly when I am having pain." This item follows from Leddy's (1997) research where 18% of respondents identified this matter. Further, open-ended question research (Cooper, 1995) found that 53% of breast cancer survivors reported this issue.
4. "I am confident I can exercise regularly without embarrassing myself." Cooper (1995) found that 33% of breast cancer survivors reported feeling embarrassed when returning to exercise, and Perna et al. (1997) found significant differences in reports of this concern between exercising and non-exercising breast cancer survivors.

See Appendix M for the modified self-efficacy scale.

Decisional balance questionnaire.

The decisional balance questionnaire by Marcus, Rakowski, et al. (1992) was used in this study. For its construction, the decisional categories of Janis and Mann (1968, 1977) were modelled in a simple pro-con structure. The Marcus, Rakowski, et al. (1992)

questionnaire measures exercise pros and cons using a five-point Likert scale ranging from 1 (not important) to 5 (extremely important). Ten items assess the pros of exercise and six assess the cons. Internal consistency (Cronbach's alpha) for the present study's modified pros scale was .96, and was .75 for the cons scale. See Appendix N for the modified decisional balance questionnaire. The decisional balance questionnaire has been shown to be significantly related to stage of change (e.g., Buxton et al, 1996; Cardinal, 1995b; Marcus & Simkin, 1994; Prochaska & Marcus, 1994).

In a sample of older adults (50 through 64 years of age), Gorely and Gordon (1995) found the Marcus, Rakowski, et al. (1992) decisional balance measure resulted in similar theoretically predicted results as those of earlier studies with middle-aged adults (e.g., Marcus, Eaton et al., 1994). Because the present study would have an age profile similar to the Gorely and Gordon (1995) sample, and because the variables were evaluated at a time point well beyond cancer treatment completion, it was assumed that the Marcus, Rakowski, et al. (1992) measure was appropriate.

However, modifications to the original measure included additional items identified by prior research to be highly relevant to breast cancer survivors. These involve including the following additional items:

1. "Regular exercise would give me a sense of control over my life." This concern was identified by open-ended question interview research (Cooper, 1995) in which numerous women discussed the pivotal role returning to exercise had in their recovery.

2. "Regular exercise would help me prevent disease." This stems from breast cancer survivor research by Young-McCaughan and Sexton (1991). These researchers utilized a

self-report ranking of pro-items, where notable differences were identified for this item between healthy and breast cancer groups.

Exercise behavior questionnaire.

The Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin, Jobin, & Bouillon, 1986; Godin & Shepard, 1985) assisted in a test of the concurrent validity of the stage of change measure. The GLTEQ contains three self-report measures which assess an individual's frequency of leisure-time strenuous, moderate, and mild exercise over an average week during the prior month (see Appendix O). Individuals are asked to only record exercise sessions of more than 20 min in duration. Jacobs, Ainsworth, Hartman and Leon (1993) have validated the GLTEQ along with nine other physical activity and exercise questionnaires.

Analyses

The demographic-medical questionnaire was analysed to describe participant characteristics. Demographic and medical variables (i.e., marital status, education, annual family income, employment status, cancer stage, surgery type, and adjuvant therapy type) were analysed with respect to TTM variables with Spearman correlations. Dichotomous variables were created for marital status (i.e., married and common law vs. never married, widowed, separated and divorced), employment status (i.e., full time and part time vs. homemaker, retired and unemployed), and adjuvant therapy type (i.e., chemotherapy vs. chemotherapy and radiotherapy). The cross-sectional exercise stage of change measure's concurrent validity was evaluated with the frequency of exercise intensity indicators from the GLTEQ. A MANOVA was completed with stage as the predictor variable, and the mild, moderate, strenuous, and a combined moderate and strenuous frequency indicator, serving as criterion variables. A significant finding was followed by one-way ANOVAs to determine which of the intensity indicators significantly differentiated stages. Tukey follow-up comparisons then established which specific stage transitions were successfully differentiated by the intensity variable.

Hypothesis one evaluates prediagnosis, active treatment, and posttreatment stage of change which was compared by chi-square analyses. As the stage variable is categorical in nature, and includes frequency data that contains only mutually exclusive and exhaustive cells, this analysis was considered appropriate. For hypotheses two through six which test processes of change use, self-efficacy, pros, cons, and decisional balance values across the stages of change, a MANOVA was used to determine whether significant differences exist among the variables. In this analysis, the stage variable acted as the predictor variable, and the TTM variables as criterion variables. This was followed by univariate ANOVAs to establish for which of the TTM constructs significant differences existed. Post hoc comparisons were performed via Tukey analyses to determine at which stage identified constructs significantly differed. Further, eta squared (η^2) values were calculated to represent the strength of relationship.

Exploratory analyses.

Although the TTM does not specify the interrelationship among its variables, it has been stated that the processes of change constructs are an attempt to explain how people make behavioral changes, and self-efficacy and decisional balance constructs explain why people make these changes (Courneya et al., 1998). This view suggests only the social-cognitive constructs should have a direct effect on the stage of change. Consequently, the processes of change constructs should have no direct effect on stage, but should have a direct effect only on the social-cognitive constructs (Courneya et al., 1998).

While a full test of these hypotheses were beyond the scope of this study, an evaluation of this relationship was performed post-hoc through exploratory analyses. First, it was investigated whether the social-cognitive constructs (i.e., self-efficacy, pros, and cons), entered together as a block, would be significant predictors of stage of change in a forced entry regression analysis. This allowed the determination of which of the social-cognitive constructs were significant predictors of exercise stage of change. Next, whether the relationship between the processes and stages of change was mediated by the social-cognitive constructs was evaluated by their addition as a second block of variables. In further analyses, the individual social-cognitive constructs were regressed on the processes of change to examine the explained variance of each individual why construct. This allowed for a determination of which of the processes of change were significant predictors of the individual social-cognitive variables.

Chapter 3

Results

Participant Characteristics

The mean age of participants was 52.3 (SD = 9.4 years; N = 178), and the mean BMI was 27.6 (SD = 5.2). The mean number of months elapsed since diagnosis was 20.2 (SD = 3.5). For those who underwent chemotherapy treatment, the mean number of months undertaken was 4.8 (n = 99; SD = 2.51), and the mean months in radiotherapy was 1.5 (n = 172; SD = 0.54). The majority of participants had been diagnosed with stage IIb cancer (n = 76; 42.7%), had a mastectomy surgery (n = 143; 80.3%), and had both chemotherapy and radiotherapy treatments (n = 81; 45.5%). The average frequency of participation in the different intensities of activities per week across all participants was mild (M = 2.00; SD = 3.51); moderate (M = 1.71; SD = 2.06); and strenuous (M = 0.73; SD = 1.51). See Table 3 - 1 for the demographic-medical profile of participants.

Exercise Stage of Change Distribution

The stage distribution for the sample prediagnosis was precontemplation (n = 20; 11.2%), contemplation (n = 17; 9.6%), preparation (n = 64; 36.0%), action (n = 5; 2.8%), and maintenance (n = 69; 38.7%). The stage distribution during treatment was precontemplation (n = 42; 23.6%), contemplation (n = 18; 10.1%), preparation (n = 83; 46.6%), and action (n = 33; 18.5%). The posttreatment stage distribution for the sample was precontemplation (n = 9; 5.1%), contemplation (n = 21; 11.8%), preparation (n = 73; 41.0%), action (n = 16; 9.0%), and maintenance (n = 59; 33.1%). For stage of change distributions across the cancer experience, see Table 3 - 2.

Transtheoretical Model Variable Relationships

Cross-sectional descriptive statistics and bivariate correlations among each of the main

Table 3 - 1

Demographic-Medical Profile of Study Participants

	n	%
Marital Status		
Married	127	71.3
Never Married	14	7.9
Divorced	13	7.3
Common Law	8	4.5
Widowed	8	4.5
Separated	7	3.9
Missing	1	0.6
Education		
Some High School	31	17.4
Completed High School	43	24.2
Some University/College	30	16.9
Completed University/College	39	21.9
Some Graduate School	12	6.7
Completed Graduate School	17	9.6
Missing	6	3.4
Annual Family Income		
< $ 20,000	14	7.9
$ 20,000 - $ 39,999	31	17.4
$ 40,000 - $ 59,999	37	20.8
$ 60,000 - $ 79,999	30	16.9
$ 80,000 - $ 99,999	15	8.4
> $ 100,000	21	11.8
Missing	30	16.9
Employment Status		
Full Time	58	32.6
Part Time	46	25.8
Homemaker	35	19.7
Retired	27	15.2
Unemployed	9	5.1
Missing	3	1.7
Cancer Stage		
I	61	34.3
IIa	24	13.5
IIb	76	42.7
IIIa	17	9.6
Surgery Type		
Mastectomy	143	80.3
Lumpectomy	34	19.1
Missing	1	0.6
Adjuvant Therapy Protocol		
Chemotherapy and Radiotherapy	81	45.5
Radiotherapy	37	20.8
Radiotherapy and Hormone Therapy	35	19.7
Chemotherapy, Radiotherapy and Hormone Therapy	25	14.0

Table 3 - 2

Stage of Change Distribution Across the Cancer Experience

	Prediagnosis (n) (%)	During Treatment (n) (%)	Posttreatment (n) (%)
Exercise Stage of Change			
Precontemplation	20 (11.2)	42 (23.6)	9 (5.1)
Contemplation	17 (9.6)	18 (10.1)	21 (11.8)
Preparation	64 (36.0)	83 (46.6)	73 (41.0)
Action	5 (2.8)	33 (18.5)	16 (9.0)
Maintenance	69 (38.7)	*	59 (33.1)

Note: Prediagnosis and during treatment stage of change frequencies do not total 100% because of missing data. * Maintenance stage of change was not assessed in the during treatment time period as inactive surgical recovery time did not allow for an elapsed activity period longer than six months.

constructs of interest are presented in Table 3 - 3.

Relationship of Demographic-Medical Variables to TTM variables

The demographic-medical variable's (i.e., marital status, education, yearly annual family income, employment status, cancer stage, surgery type, adjuvant therapy type, BMI, and age) relationship with the TTM variables was assessed with Spearman correlations. A total of 126 bivariate correlations were calculated. No demographic-medical variable was correlated with the outcome variable (i.e., stage), or more than three TTM constructs. None had more than a small effect size (Cohen, 1992), or had a systematic relationship with any definable grouping of variables (e.g., processes of change, social-cognitive).

Concurrent Validity

A test of the concurrent validity of the exercise stage of change measure was performed. The modified stage measure's (Courneya, 1995b) definition of exercise corresponds to that of both the moderate and strenuous intensity indicators of the GLTEQ. As such, it was hypothesized that a combined moderate and strenuous exercise frequency indicator would be able to differentiate the combined precontemplation and contemplation stages (i.e., non-exercisers), the preparation stage (i.e., irregular exercisers), and the combined action and maintenance stages (i.e., regular exercisers).

Concurrent validity of the stage of change measure was evaluated with the self-report frequency indicators of mild, moderate and strenuous exercise from the GLTEQ. As per operational stage definitions (Marcus, Selby, et al., 1992) inactive stages (i.e., precontemplation and contemplation), the occasionally active stage (i.e., preparation), and

Table 3 - 3

Correlation Coefficient Matrix, Means, and Standard Deviations for Stages of Change, Self-Efficacy, Decisional Balance, and Processes of Change Constructs

	2	3	4	5	6	7	8	9	10	11	12	13	14	Mean	SD
1. Stage	.47 **	.39 **	-.18 *	.35 **	.18 *	.03	.29 **	.26 **	.54 **	.59 **	.66 **	.29 **	.38 **		
2. Self-efficacy		.34 **	-.34 **	.32 **	.20 **	.07	.18 *	.20 **	.46 **	.44 **	.61 **	.30 **	.27 **	5.98	2.04
3. Pros			.04	.53 **	.39 **	.41 **	.69 **	.39 **	.46 **	.41 **	.59 **	.33 **	.32 **	3.79	1.04
4. Cons				-.02	.20 **	.13	.05	.03	-.02	-.04	-.11	.10	-.03	2.24	0.86
5. Consciousness raising					.53 **	.46 **	.63 **	.59 **	.51 **	.47 **	.52 **	.43 **	.36 **	2.96	1.11
6. Dramatic relief						.54 **	.56 **	.42 **	.40 **	.36 **	.39 **	.34 **	.25 **	2.60	1.20
7. Environmental reevaluation							.65 **	.39 **	.28 **	.29 **	.28 **	.26 **	.23 **	2.71	0.93
8. Self-reevaluation								.42 **	.53 **	.45 **	.53 **	.32 **	.31 **	3.28	1.10
9. Social liberation									.45 **	.45 **	.44 **	.44 **	.44 **	2.54	0.92
10. Self-liberation										.72 **	.64 **	.44 **	.42 **	3.34	1.01
11. Reinforcement management											.65 **	.52 **	.47 **	2.75	0.93
12. Counterconditioning												.52 **	.48 **	3.03	1.04
13. Stimulus control													.40 **	1.86	0.73
14. Helping relationships														1.95	0.96

Note: All correlations with the stage variable utilize Spearman correlations, all other variables use Pearson correlations. ** $p < 0.01$ (2 - tailed); * $p < 0.05$ (2 - tailed).

active stages (i.e., action, maintenance) were combined. A MANOVA revealed stage of change was significantly related to the three indicators of intensity [Wilks' $\lambda = .667$; $F(6, 346) = 12.95$, $p < .001$]. Subsequently, univariate ANOVAs on the individual levels of intensity revealed significant relationships between stage of change and the moderate [$F(2, 175) = 16.63$, $p < .001$], strenuous [$F(2, 175) = 20.94$, $p < .001$], and the combined moderate and strenuous exercise frequency variable [$F(2, 175) = 34.9$, $p < .001$]. However, the mild indicator was not found to be significant [$F(2, 175) = 2.66$, $p > .05$]. Tukey follow-up comparisons showed the moderate and moderate plus strenuous frequency indicators differentiated all predicted stage transitions. Means, standard deviations, and Tukey follow-up analyses for the reported frequencies from the GLTEQ intensity indicators are presented in Table 3 - 4.

In an evaluation of the stage of exercise change measure's ability to classify individuals on their exercise behavior, calculations of sensitivity and specificity were performed. Sensitivity is the ratio of cases correctly classified as true positives, to all cases that meet the reference criterion (Lee, Nigg, DiClemente, & Courneya, 1999). Sensitivity was calculated based on the exercise stage of change measure's ability to predict which participants would meet each stage's defined exercise frequency levels indicated by the GLTEQ. Specificity is the ratio of those correctly classified as true negatives to all cases that do not meet the reference criterion (Lee et al.,1999). Specificity was calculated based on the exercise stage of change measure's ability to predict which participants would be excluded from the algorithm's defined exercise frequency levels as indicated by the GLTEQ.

Table 3 - 4

Means, Standard Deviations, and Tukey Follow-Up Analyses by Stage of Change

		Exercise Stage of Change			
		PC / CO (n = 30)	PR (n = 73)	AX / MN (n = 75)	Comparisions*
Strenuous	M	0.03	0.22	1.50	AX/MN>PR
	SD	(0.18)	(0.92)	(1.89)	AX/MN>PC/CO
Moderate	M	0.17	1.53	2.50	AX/MN>PR>PC/CO
	SD	(0.59)	(1.61)	(2.43)	
Mild	M	0.83	1.92	2.55	NS
	SD	(1.70)	(2.85)	(4.42)	
Strenuous +	M	0.20	1.75	4.00	AX/MN>PR>PC/CO
Moderate	SD	(0.61)	(2.16)	(2.78)	

* Note: All Tukey post-hoc tests $p < .05$. PC = Precontemplation; CO = Contemplation; PR = Preparation; AX = Action; MN = Maintenance. NS = not significant.

The reference criterion was operationalized as per the exercise stage measure's definitions (Courneya, 1995b). It suggests that individuals in the precontemplation and contemplation stages would self-report an exercise frequency of zero times per week. Frequency of exercise in the preparation stage would be one or two times per week. Lastly, those individuals in action and maintenance stages would report frequencies greater than three times per week. Sensitivity and specificity calculations for the exercise stage of change measure with the GLTEQ exercise frequency indicator are presented in Table 3 - 5.

Hypotheses Testing

Hypothesis one.

The maintenance stage of change was not assessed in the during treatment time period as a total duration of regular exercise beyond six months was not possible because cancer treatment rarely lasts beyond six months. To create a common four stage measure across all time periods, the action and maintenance stages were collapsed for both the prediagnosis and posttreatment time periods. This technique allows for chi-square analyses on the resulting indicator. It is argued that even when action and maintenance stages are collapsed, the ability to draw important conclusions about stage movements prior to these stages still remains.

Chi-square analyses revealed a significant relationship in stage distribution between the prediagnosis and during treatment [χ^2 (9, $\underline{N}$ = 175) = 50.64, $\underline{p} < .001$] time periods. A significant relationship was also found between the during treatment and posttreatment periods [χ^2 (9, $\underline{N}$ = 176) = 40.83, $\underline{p} < .001$]. Further, prediagnosis and posttreatment also

Table 3 - 5

Summary of Sensitivity and Specificity Evaluation of the Stage of Change Measure

Stage of Change*	Sensitivity (%)	Specificity (%)
Precontemplation / Contemplation	86.7	72.3
Preparation	32.9	93.3
Action / Maintenance	57.3	77.7

* Note: Precontemplation and contemplation are combined as they both are defined as zero bouts of exercise per week (i.e., inactive). Preparation is defined as either one or two bouts of exercise per week (i.e., occasionally active). Action and maintenance are also combined because they are defined as three or more bouts of exercise per week (i.e., active).

differed significantly [χ^2 (9, N = 178) = 107.88, $p < .001$).

The following analyses utilize the original unmodified stage measure self-reported in the questionnaire. First, an initial test of the practical significance of the prior stage transition analyses, involved a descriptive comparison of the number of individuals in the active stages (i.e., action and maintenance) in the prediagnosis and posttreatment time periods. It revealed nearly identical numbers in these active stages during prediagnosis (n = 74) and posttreatment (n = 73). A subsequent analysis showed the absolute numbers of stage regressions (n = 29) was nearly equal to stage progressions (n = 31) between prediagnosis and posttreatment. See Table 3 - 6 for stage transitions and Table 3 - 7 for rates of stage progression and regression.

Hypotheses two through six.

A preliminary MANOVA with posttreatment stage as the predictor variable, and the TTM variables as criterion variables, was performed. Findings revealed significant differences among the TTM variables across the stages of change [Wilks' $\lambda = .285$; $F(52, 626) = 4.60$, $p < .001$]. Univariate ANOVAs indicate that all constructs, except dramatic relief, significantly differentiated at least one stage from another (ps < .05). The means, standard deviations, F statistics, and standardized effect sizes (η^2) for each construct across the stages of change are presented in Table 3 - 8.

Using the guidelines suggested by Cohen (1992) for interpreting effect sizes in the behavioral sciences, the relationship between stage and the TTM variables may be represented as large for the behavioral processes of change and counterconditioning. Medium effect sizes were noted for self-liberation, reinforcement management, and self-

Table 3 - 6
Stage Transitions Over the Cancer Experience

Transition	PC n (%)	CO n (%)	PR n (%)	AX n (%)	MN n (%)	Total
Prediagnosis to During Treatment						
Precontemplation	11 (55.0)	0 (0)	6 (30.0)	3 (15.0)	*	20
Contemplation	7 (41.2)	6 (35.3)	4 (23.5)	0 (0)	*	17
Preparation	19 (30.2)	5 (7.9)	34(52.4)	6 (9.5)	*	64
Action	1 (20.0)	0 (0)	2 (40.0)	2 (40.0)	*	5
Maintenance	4 (5.8)	7 (10.1)	36 (52.2)	22 (31.9)	*	69
Total	42	18	82	33	*	
During Treatment to Posttreatment						
Precontemplation	6 (14.3)	11 (26.2)	16 (38.1)	4 (9.5)	5 (11.9)	42
Contemplation	0 (0)	5 (27.8)	7 (38.9)	2(11.1)	4 (22.2)	18
Preparation	2 (2.4)	4 (4.8)	42 (50.6)	8 (9.6)	27 (32.5)	83
Action	1 (3.0)	1 (3.0)	8 (24.2)	1 (3.0)	22 (66.7)	33
Maintenance	*	*	*	*	*	*
Total	9	21	73	15	58	
Prediagnosis to Posttreatment						
Precontemplation	6 (30.0)	1 (5.0)	7 (35.0)	3 (15.0)	3 (15.0)	20
Contemplation	1 (5.9)	9 (52.9)	4 (23.5)	1 (5.9)	2 (11.8)	17
Preparation	1 (1.6)	9 (14.1)	44 (69.0)	3 (4.7)	7 (10.9)	64
Action	0 (0)	0 (0)	2 (40.0)	1 (20.0)	2 (40.0)	5
Maintenance	1 (1.4)	2 (2.9)	15 (21.7)	7 (10.1)	44 (63.8)	69
Total	9	21	72	15	58	

Note: PC = Precontemplation; CO = Contemplation; PR = Preparation; AX = Action; MN = Maintenance. * Maintenance was not assessed in the during treatment time period because an inactive surgical recovery time would not allow for activity levels beyond six months in duration.

Table 3 - 7

Stage Progression, Regression, and Stability Over the Cancer Experience

Transition	n
Prediagnosis to During Treatment	
Regression	78
Stability	73
Progression	19
During Treatment to Posttreatment	
Regression	16
Stability	73
Progression	82
Prediagnosis to Posttreatment	
Regression	29
Stability	110
Progression	31

Table 3 - 8

Means (Standard Deviations) for Self-Efficacy, Decisional Balance, Cognitive, Behavioral, and the Individual Process of Change Constructs Across the Stages of Change at the Posttreatment Time Period

	Stage						
	PC	CO	PR	AX	MN	$F_{(4,173)}$	η^2
Self-efficacy	5.49 (2.01)	4.50 (1.97)	5.34 (1.78)	6.00 (2.10)	7.38 (1.58)	15.40	.263
Pros	1.98 (0.93)	3.87 (0.89)	3.61 (0.98)	3.79 (0.77)	4.25 (0.87)	13.36	.236
Cons	1.99 (0.77)	2.43 (0.70)	2.47 (0.84)	1.94 (0.75)	2.00 (0.90)	3.53	.075
Cognitive	1.66 (0.55)	2.73 (0.62)	2.80 (0.85)	2.76 (0.64)	3.06 (0.81)	6.45	.130
Behavioral	1.50 (0.39)	1.98 (0.43)	2.40 (0.63)	2.84 (0.64)	3.13 (0.59)	29.96	.409
Consciousness raising	1.72 (0.54)	2.71 (0.88)	2.84 (1.07)	2.65 (0.80)	3.47 (1.13)	7.79	.153
Dramatic relief	1.67 (1.12)	2.35 (1.05)	2.63 (1.19)	2.57 (1.25)	2.81 (1.21)	2.10[1]	.046
Environmental reevaluation	1.81 (0.69)	2.87 (0.96)	2.84 (0.89)	2.59 (0.86)	2.67 (0.97)	2.82	.061
Self-reevaluation	1.50 (0.76)	3.14 (0.93)	3.28 (1.14)	3.65 (0.71)	3.50 (0.98)	8.22	.160
Social liberation	1.62 (0.70)	2.60 (0.92)	2.42 (0.90)	2.35 (0.84)	2.86 (0.88)	4.97	.103
Self-liberation	2.09 (0.93)	2.68 (0.81)	3.09 (0.87)	3.75 (0.82)	3.98 (0.86)	18.56	.300
Reinforcement management	1.33 (0.48)	2.15 (0.65)	2.55 (0.73)	2.92 (0.75)	3.39 (0.84)	23.43	.351
Counterconditioning	1.47 (0.52)	2.19 (0.63)	2.73 (0.92)	3.43 (0.57)	3.84 (0.74)	34.15	.441
Stimulus control	1.42 (0.60)	1.49 (0.47)	1.80 (0.68)	2.03 (0.84)	2.08 (0.76)	4.26	.090
Helping relationships	1.17 (0.35)	1.38 (0.44)	1.83 (0.96)	2.09 (0.97)	2.37 (0.97)	7.39	.146

Note: PC = Precontemplation; CO = Contemplation; PR = Preparation; AX = Action; MN = Maintenance. All Tukey post hoc tests $p < .05$. [1]Not significant.

efficacy. Lastly, small effect sizes were found for pros, cognitive processes of change, consciousness raising, self-reevaluation, social liberation, and helping relationships. Cohen (1992, p. 156) interprets medium effect sizes as those able to "represent an effect likely to be visible to the naked eye of a careful observer", this quote provides a practical representation of the strength of TTM constructs individually and as a whole.

Tukey follow-up analyses were performed to determine each construct's ability to differentiate the stages of change (see Table 3 - 9).

Self-efficacy.

The hypothesized linear increase in self-efficacy was not found from the precontemplation through maintenance stages. An initial mean peak in the precontemplation stage was greater than that of both the contemplation and preparation stages which prevented the hypothesized linear relationship from emerging. For the mean levels of self-efficacy across the stages of change, see Figure 3 - 1.

Pros.

The hypothesized linear increase in pros was not found from the precontemplation through maintenance stages. A measure of pros was shown to increase across stages, except for a larger than expected value in contemplation that prevented a positive linear relationship from being found. For the mean level of pros across the stages of change, see Figure 3 - 2.

Cons.

The hypothesized linear decrease in cons was not found from the precontemplation through maintenance stage. The cons revealed an inconsistent relationship between

Table 3 - 9

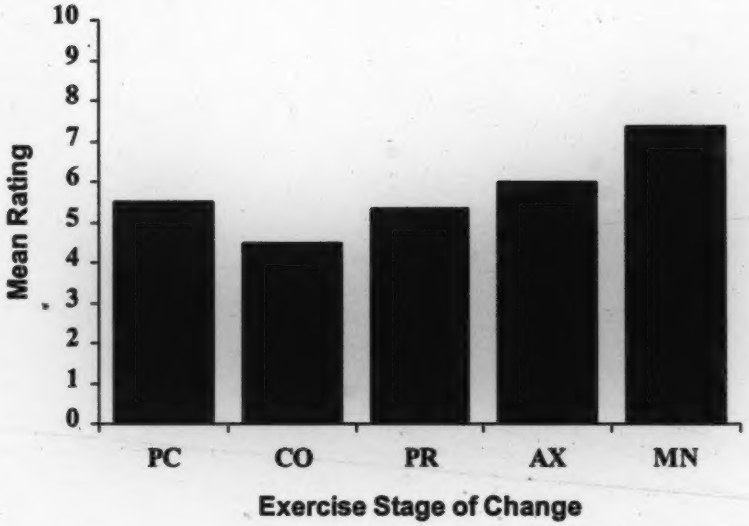
Tukey Follow-Up Analyses for the Transtheoretical Model Variables Between the Stages of Change During the Posttreatment Time Period

	Comparison
Self-efficacy	MN>AX,PR,CO,PC
Pros	MN,AX,PR,CO>PC MN>PR
Cons	PR>MN
Cognitive	MN,AX,PR,CO>PC
Behavioral	MN,AX>PR>CO,PC
Consciousness raising	MN>AX,PR,CO,PC PR>PC
Dramatic relief	NS
Environmental reevaluation	AX,PR,CO>PC
Self-reevaluation	MN,AX,PR,CO>PC
Social liberation	MN>PR,PC CO>PC
Self-liberation	MN>PR,CO,PC AX>PR,CO,PC PR>PC
Reinforcement management	MN>PR,CO,PC AX>PC PR>PC
Counterconditioning	MN>PR,CO,PC AX>PR,CO,PC PR>CO,PC
Stimulus control	MN>CO,PC
Helping relationships	MN>PR,CO,PC

Note: PC = Precontemplation; CO = Contemplation; PR = Preparation; AX = Action; MN = Maintenance. All Tukey post hoc tests $p < .05$. NS = Not significant.

Figure 3 - 1

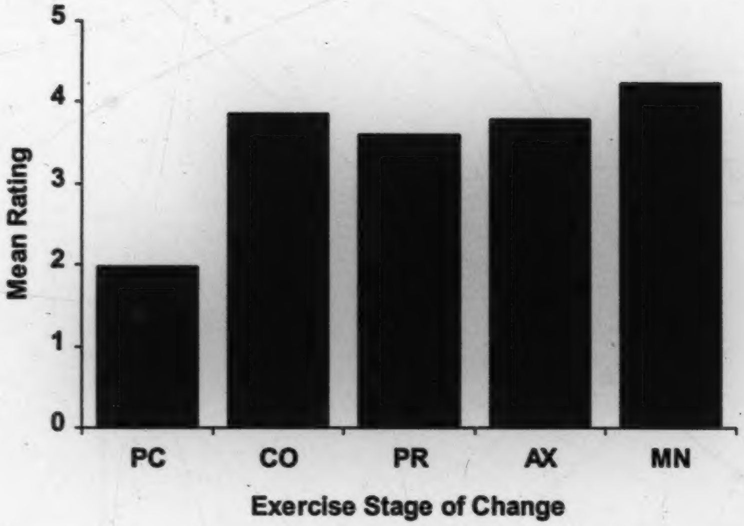
Mean Self-Efficacy Across the Stages of Change



Note: Self-efficacy is measured on an 11-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 2

Mean Pros Across the Stages of Change



Note: Pros are measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

precontemplation and maintenance stages. Counter to the hypothesis, the largest values for the cons measure were actually found at the contemplation and preparation stages. For the mean level of cons across the stages of change, see Figure 3 - 3.

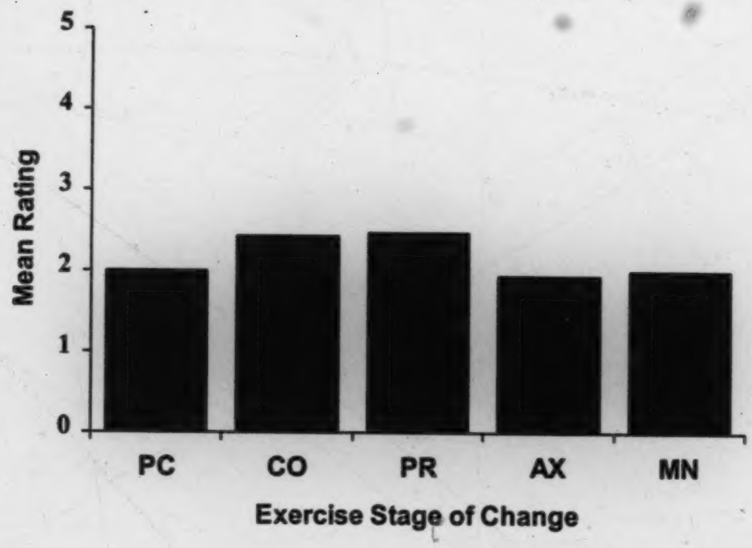
Decisional balance and pro-con crossover.

In a method similar to Nigg and Courneya (1998), a repeated measures MANOVA was used to view the pros and cons differences across the stages. A within-subjects effect would indicate that an overall mean pros and cons difference was found within the individual stages. A between-subjects effect would indicate that the pros and cons differences were significantly distinct between stages. An interaction, the effect of interest, indicates a pros-cons difference indicator varied across the stages suggesting a pro-con crossover. To aid in the comparison to prior literature, pro-con crossover calculations were performed with both T-scores (i.e., M = 50, SD = 10) and raw scores.

T-scores. The MANOVA was statistically significant [Wilks' $\lambda = .803$; $F(4, 173) = 10.59$, $p < .001$]. The analysis revealed a significant between subjects effect [$F(4, 173) = 5.79$, $p < .001$], a non-significant within subjects effect [$F(1, 173) = 2.40$; $p > .05$], and a significant interaction [$F(4, 173) = 10.59$; $p < .001$]. This shows the decisional balance index (i.e., pros minus cons) varied across stage, and allowed for a comparison of the pros and cons means in the different stages. Thus, a series of paired samples t-tests were done, one for each of the stages of change. The pros and cons means were significantly different in the precontemplation stage [$t(8) = 3.46$, $p < .009$], but was not in contemplation [$t(20) = .47$, $p > .05$], was again in preparation [$t(72) = 2.85$, $p < .007$], not significant in action [$t(15) = -1.33$, $p > .05$, and significant again in maintenance [$t(58) = -$

Figure 3 - 3

Mean Cons Across the Stages of Change



Note: Cons are measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

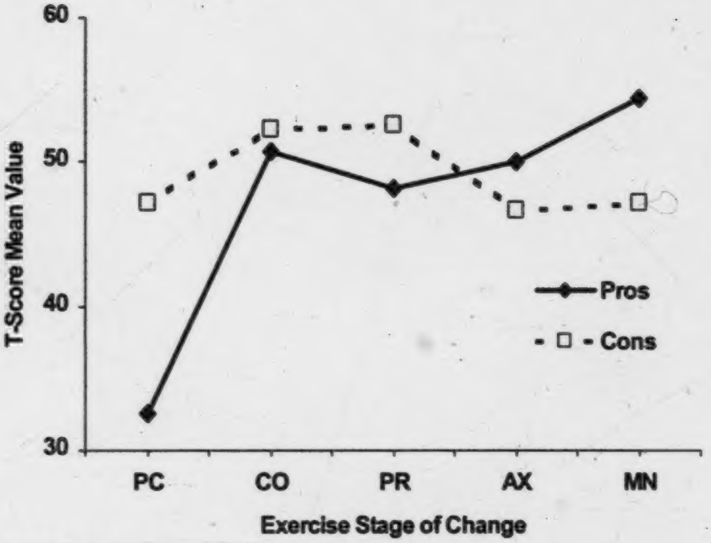
4.83, $p < .001$]. This suggests the pro-con crossover exists at the action stage. See Figure 3 - 4 for a representation of the T-score crossover.

Raw scores. The MANOVA was statistically significant [Wilks' $\lambda = .788$; $F(4, 173) = 11.61$, $p < .001$]. The analysis revealed a significant between subjects effect [$F(4, 173) = 5.53$, $p < .001$], a significant within subjects effect [$F(1, 173) = 126.29$; $p < .001$], and a significant interaction [$F(4, 173) = 11.61$; $p < .001$]. This shows the decisional balance index varied across stage, and allowed a comparison of the pros and cons means in the different stages. A series of paired samples t-tests were done, one for each of the stages of change. The decisional balance index was not significant for the precontemplation stage [$t(8) = .028$, $p > .05$], but was for contemplation [$t(20) = -4.858$, $p < .001$], preparation [$t(72) = -7.781$, $p < .001$], action [$t(15) = -7.539$, $p < .001$], and maintenance [$t(58) = -16.204$, $p < .001$] stages. This suggests that the pros and cons intersected in the precontemplation stage of change. See Figure 3 - 5 for a representation of the raw score pro-con cross over.

Cognitive processes of change. The hypothesised increase in cognitive processes of change use between precontemplation and contemplation, and the consistency between contemplation and preparation, was found. However, the predicted increase from preparation to action, and the decrease between action and maintenance, was not found. For the mean level of the cognitive processes across the stages of change, see Figure 3 - 6. For the individual processes, see consciousness raising (Figure 3 - 7), dramatic relief (Figure 3 - 8), environmental reevaluation (Figure 3 - 9), self-reevaluation (Figure 3 - 10), and social liberation (Figure 3 - 11).

Figure 3 - 4

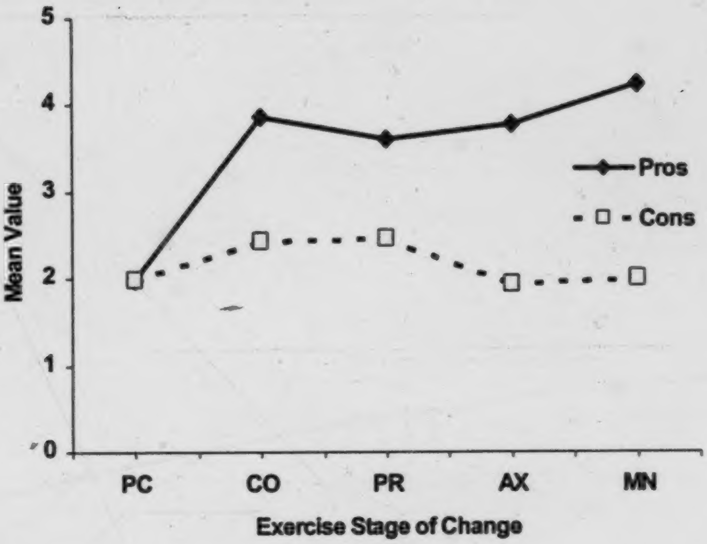
T-Score Pro-Con Crossover



Note: PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 5

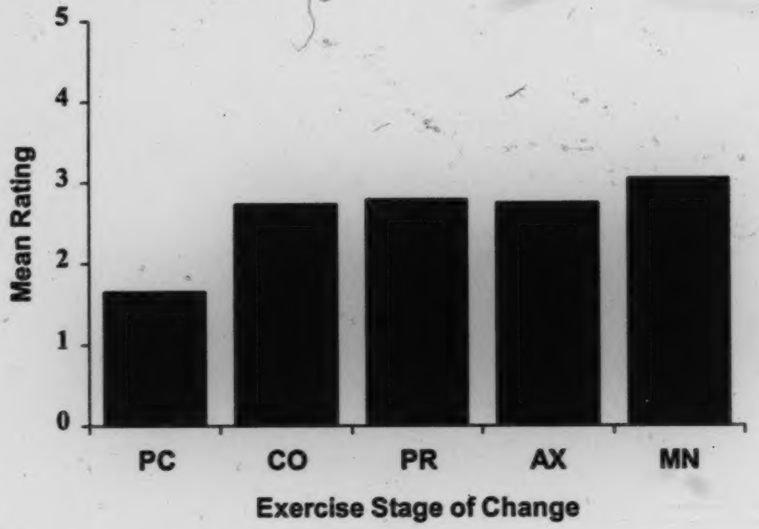
Raw Score Pro-Con Crossover



Note: Pros and cons are measured on five-point scales. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 6

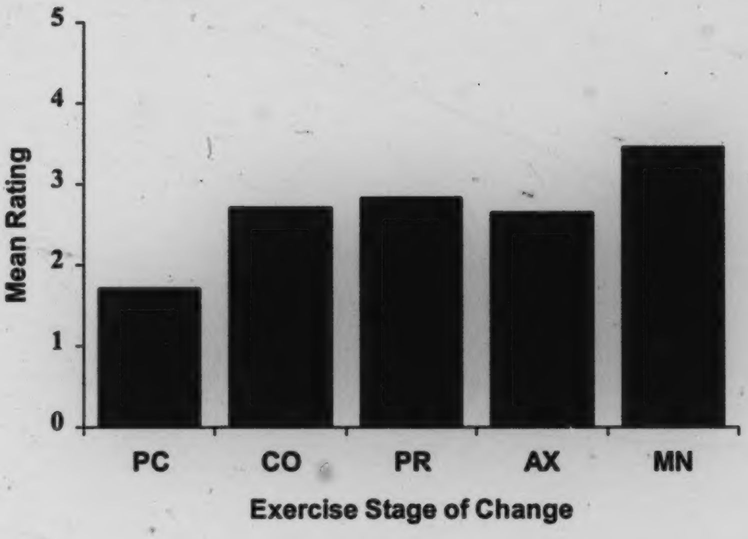
Mean Cognitive Processes of Change Across the Stages of Change



Note: Cognitive processes of change are measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 7

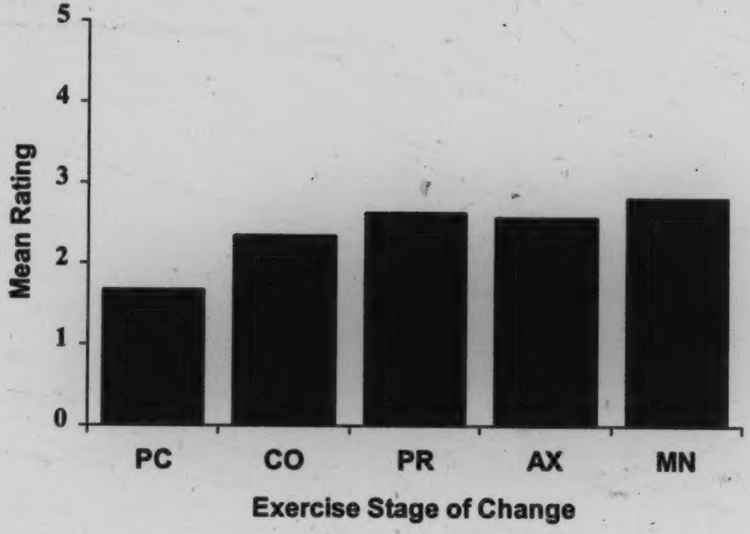
Mean Consciousness Raising Across the Stages of Change



Note: Consciousness raising is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 8

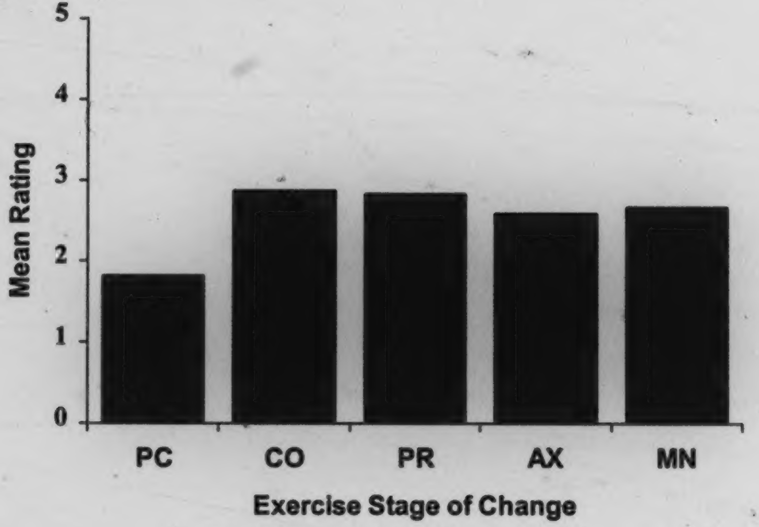
Mean Dramatic Relief Across the Stages of Change



Note: Dramatic relief is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 9

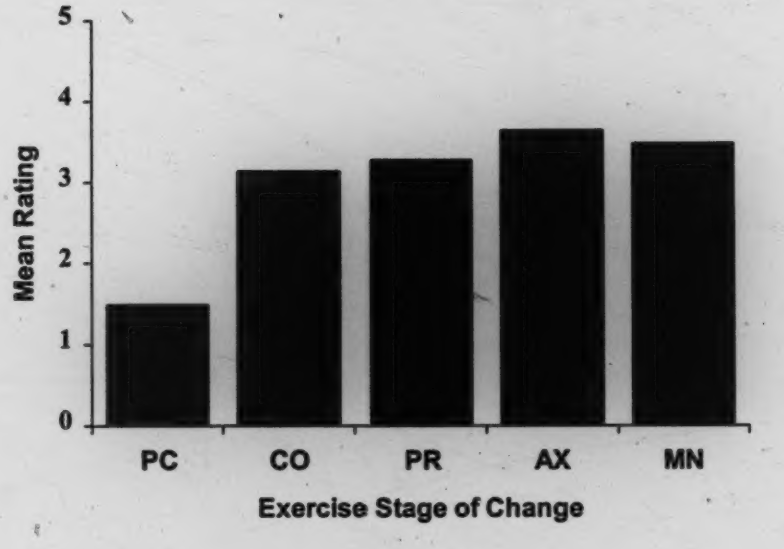
Mean Environmental Reevaluation Across the Stages of Change



Note: Environmental reevaluation is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 10

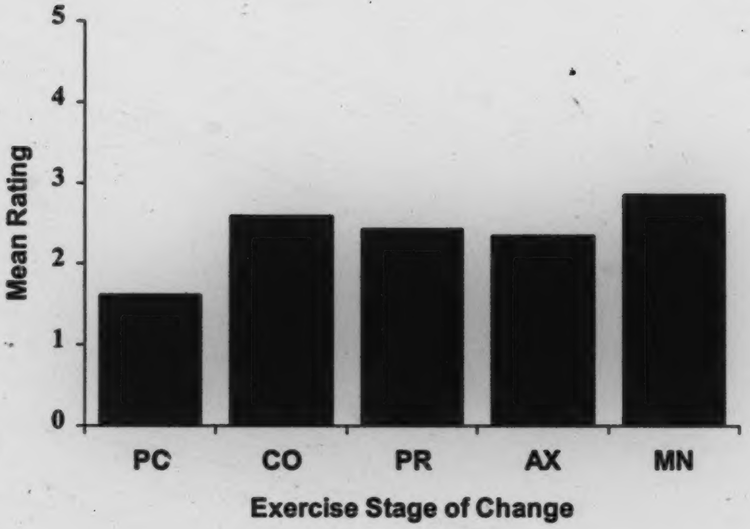
Mean Self-Reevaluation Across the Stages of Change



Note: Self-reevaluation is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 11

Mean Social Liberation Across the Stages of Change



Note: Social liberation is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

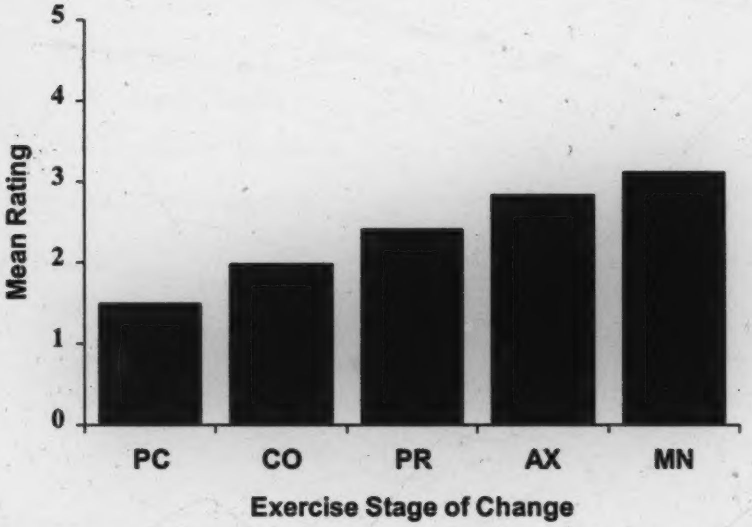
When evaluating the individual process use across the stages of change, consciousness raising, dramatic relief, and social liberation shared a pattern which saw a distinct low use in the precontemplation stage, and a defined peak in the maintenance stage. However, mean values in contemplation, preparation, and action varied little. While the pattern was similar among these processes, consciousness raising generally exhibited much larger mean differences across the stages.

The environmental reevaluation and self-reevaluation processes also shared a pattern, with a very distinct low in precontemplation, and a less clear relationship existing through the more advanced stages. Notably, maintenance did not yield the highest mean values as it did with consciousness raising, dramatic relief, and social liberation, or with the individual behavioral processes. Additionally, mean values between stages were much larger across the stages for the self-reevaluation construct than for environmental reevaluation.

Behavioral processes of change. The hypothesized linear and increasing representation of the behavioral processes of change use from precontemplation through action was found. However, a levelling off was not seen between the action and maintenance stages. For the mean level of the behavioral processes across the stages of change see Figure 3 - 12. For the mean level of the individual behavioral processes see self-liberation (Figure 3 - 13), reinforcement management (Figure 3 - 14), counterconditioning (Figure 3 - 15), stimulus control (Figure 3 - 16), and helping relationships (Figure 3 - 17). In regard to the individual processes, counterconditioning, reinforcement management, and self-liberation all showed very large and linear mean

Figure 3 - 12

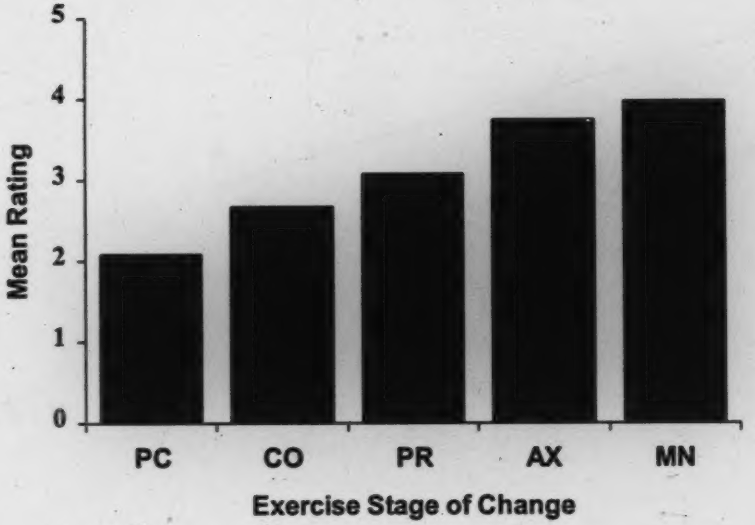
Mean Behavioral Processes of Change Across the Stages of Change



Note: Behavioral processes are measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 13

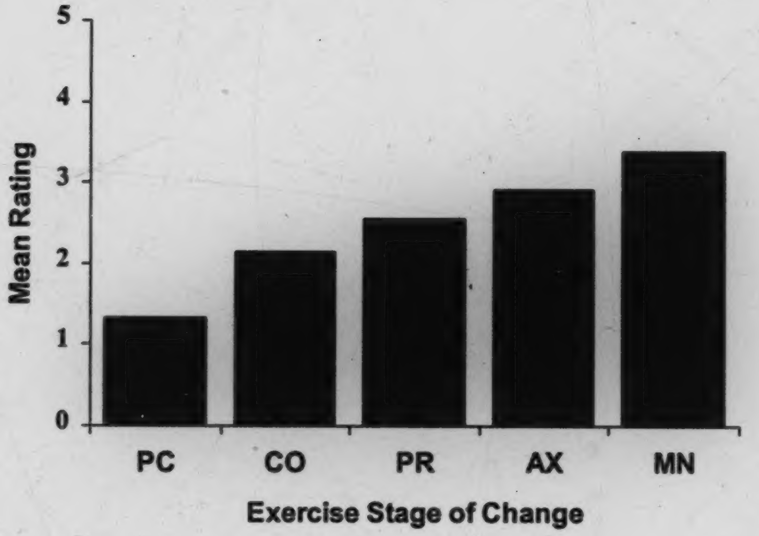
Mean Self-Liberation Across the Stages of Change



Note: Self-liberation is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 14

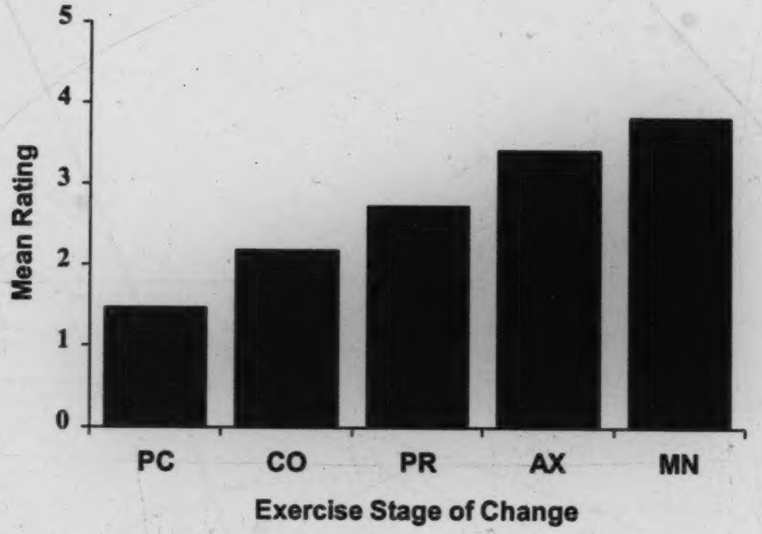
Mean Reinforcement Management Across the Stages of Change



Note: Reinforcement management is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 15

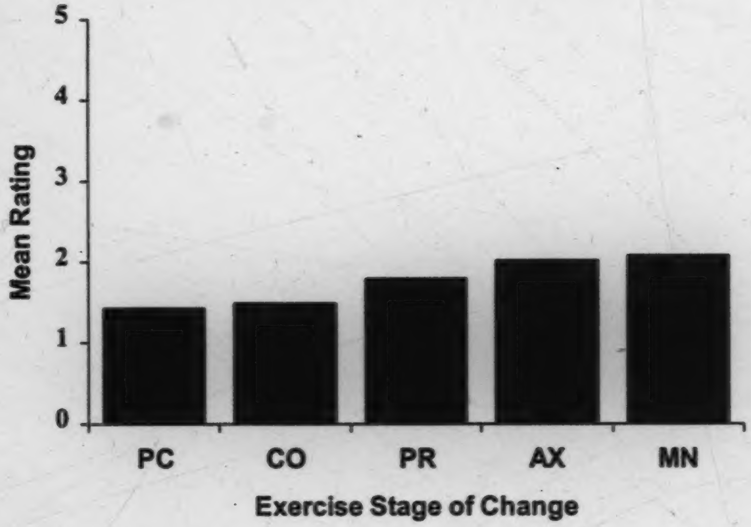
Mean Counterconditioning Across the Stages of Change



Note: Counterconditioning is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 16

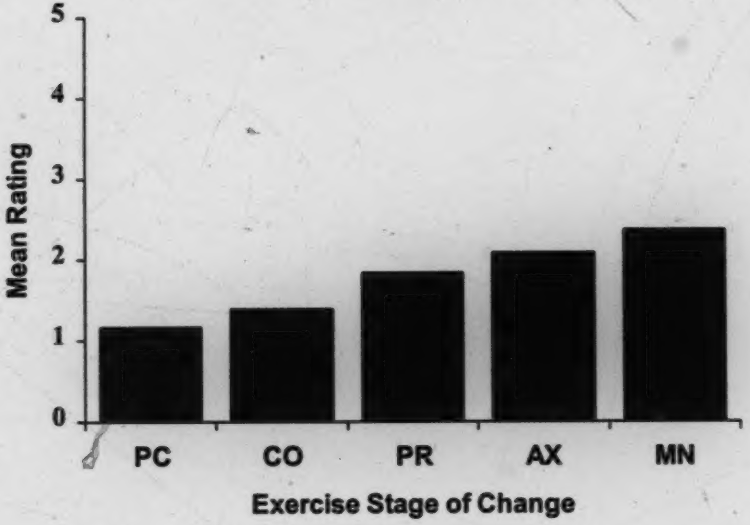
Mean Stimulus Control Across the Stages of Change



Note: Stimulus control is measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

Figure 3 - 17

Mean Helping Relationships Across the Stages of Change



Note: Helping relationships are measured on a five-point scale. PC = precontemplation; CO = contemplation; PR = preparation; AX = action; MN = maintenance.

difference scores across all the five stages of change. Helping relationships and stimulus control processes use approximated the above pattern, but it did not include such distinctive mean differences across the stages.

Exploratory Analyses

Linear regression was chosen over the discriminant function technique for the exploratory analyses. Because the stage variable was at least ordinal in nature, and its relationship to the predictors was linear, it was considered appropriate. However, the following analyses were first performed through discriminant function, then subsequently through regression analyses. This was done to ensure that the relative strength of predictors identified in the discriminant analyses corresponded to those in the regression analyses. As all results supported this contention, only the findings of the regression analyses are presented.

In the first exploratory analysis, forced entry regression analysis was performed with stage of change first regressed on the self-efficacy, pros and cons variables of the TTM. A second block included the 10 processes of change. The first block together explained 28.4% of the variance in stage of change. Standardized regression coefficients were significant for both self-efficacy and pros. Forced entry of the processes of change removed the significance of all the first block's standardized regression coefficients. Total explained variance through both blocks was 55.0% with only three processes (i.e., counterconditioning, reinforcement management, and environmental reevaluation) showing significant standardized regression coefficients (see Table 3 - 10).

Next, a second forced entry regression analysis of self-efficacy on processes of change

Table 3 - 10

Regression of Stage of Change on Transtheoretical Model Variables

	R^2	R^2_{change}	F_{change}	β_1	β_2
Block 1					
Self-efficacy				.358***	-.009
Pros				.271***	.089
Cons	.284	.284	23.04***	-.066	-.064
Block 2					
Consciousness raising					.091
Dramatic relief					-.028
Environmental reevaluation					-.168*
Self-reevaluation					-.091
Social liberation					-.073
Self-liberation					.123
Reinforcement management					.280***
Counterconditioning					.472***
Stimulus control					-.124
Helping relationships	.550	.266	15.45***		.063

Note: β_1 = Standardized regression coefficients are based only on the first block entered (i.e., self-efficacy, pros, and cons). β_2 = Standardized regression coefficients are based on both blocks entered (i.e., full model). * $p < .05$; ** $p < .01$; *** $p < .001$.

was performed to examine the determinants of this construct (see Table 3 - 11). Only consciousness raising, self-liberation, and self-reevaluation had significant standardized coefficients in the regression equation. The three constructs together explained 44.2% of the variance in self-efficacy. In a third regression analysis, self-reevaluation and counterconditioning were the only significant determinants of the pros construct, together explaining 54.8% of the variance (see Table 3 - 12).

Table 3 - 11

Regression of Self-Efficacy on the Processes of Change

	R^2	F_{change}	β
Consciousness raising			.168***
Dramatic relief			.017
Environmental reevaluation			.030
Self-reevaluation			-.332***
Social liberation			-.120
Self-liberation			.199*
Reinforcement management			.035
Counterconditioning			.628
Stimulus control			-.051
Helping relationships	.442	13.25***	-.033

Note: β_1 = Standardized regression coefficients are based only on the first block entered (i.e., self-efficacy, pros, and cons). β_2 = Standardized regression coefficients are based on both blocks entered (i.e., full model). * $p < .05$; ** $p < .01$; *** $p < .001$.

Table 3 - 12

Regression of the Pros on the Processes of Change

	R^2	$\underline{F}_{change}$	β
Consciousness raising			.071
Dramatic relief			-.040
Environmental reevaluation			-.029
Self-reevaluation			-.524***
Social liberation			-.040
Self-liberation			.003
Reinforcement management			-.076
Counterconditioning			.325***
Stimulus control			-.003
Helping relationships	.548	20.21***	.009

Note: β_1 = Standardized regression coefficients are based only on the first block entered (i.e., self-efficacy, pros, and cons). β_2 = Standardized regression coefficients are based on both blocks entered (i.e., full model). * $\underline{p} < .05$; ** $\underline{p} < .01$; *** $\underline{p} < .001$.

Chapter 4

Discussion

The purpose of this study was to apply the complete TTM (i.e., self-efficacy, decisional balance, and processes of change) as a framework for understanding exercise behavior in breast cancer survivors after the completion of their cancer treatment. After the identification of potential participants through the Alberta Cancer Registry, and approval from physicians was gained, questionnaires were posted, and TTM variables and exercise behavior were assessed cross-sectionally. Exercise stage of change was assessed retrospectively for prediagnosis and during treatment time periods. This study advances the TTM and exercise literature with a multivariate analysis of the model variables, a complex form of analyses presently utilized in only two other studies (Gorely & Gordon, 1995; Nigg & Courneya, 1998). Further, exercise determinant research is advanced by this premier application of a stage model to the understanding of exercise behavior change in cancer survivors.

In general, weak support for the applicability of the TTM in the understanding of exercise stage of change in breast cancer survivors was found. All TTM constructs, except dramatic relief, were found to distinguish at least one stage of change from another. However, most individual hypotheses were only partially supported.

Modified Self-Efficacy and Decisional Balance Questionnaires

The modified decisional balance and self-efficacy questionnaires both performed very well in the breast cancer survivor sample. Coefficient alpha for the original pros (10 items) and cons (6 items) measures (Marcus, Rakowski, et al., 1992) were .95 and .79

respectively. The present study's modified questionnaire for breast cancer survivors, which included an additional two pros items, had pros and cons coefficient alphas of .96 and .75 respectively. Coefficient alpha for the original five-item self-efficacy measure (Marcus, Selby, et al., 1992) was .82. The present study's nine-item scale showed an improved internal reliability of .91 (coefficient alpha). The consistent reliability of the modified decision balance questionnaire, and the improved reliability of the self-efficacy questionnaire, suggest the appropriateness of the population-specific additional items added to the questionnaire.

Demographic-Medical Variable Relationships to the TTM Variables

Analyses of the relationship between demographic-medical and TTM variables showed that no systematic relationships exist among the variables. Within the 126 correlations, no demographic-medical variable was correlated with stage, with more than three TTM constructs, or had more than a small effect size (Cohen, 1992). Further, a number of significant correlations would be expected by chance alone considering the large total number of correlations performed. These findings suggest that both demographic and medical profiles offer little to the understanding of exercise motivation in breast cancer survivors.

Concurrent Validity of the Exercise Stage of Change Measure

Concurrent validity of the cross-sectional exercise stage of change measure (Marcus, Selby et al., 1992) was shown through the ability of the GLTEQ's frequency of exercise intensity indicators to correctly classify individuals into the proper stage of change category. Tukey follow-up comparisons showed that both the moderate and moderate plus strenuous indicators differentiated the inactive, occasionally and regularly active patterns suggested by the exercise stage of change definitions (Courneya, 1995b).

Previous findings have supported the exercise stage of change's concurrent validity with the GLTEQ through both a dichotomous exercise question (Cardinal, 1997b), and an exercise index in METS (e.g., Cardinal, 1997b; Wyse et al., 1995; Courneya & Nigg, 1998). Most studies have revealed the predicted mean differences in METS, however, this method may not be the best method of stage validation using the GLTEQ. Exercise is defined as activities of at least moderate intensity performed on a repeated basis over an extended period of time with the intention of improving physical fitness and health (American College of Sports Medicine, 1998). By including mild indicators and through weighting frequency by intensity in METS, changes are made contrary to the exercise definition (e.g., 6 hours of golf would be considered comparable to 1.5 hours of running).

This study suggests a more appropriate analyses is of the GLTEQ's combined moderate and strenuous frequency indicators alone. In an analysis of the mild, moderate, and strenuous frequency indicators from the GLTEQ, Wyse et al. (1995) showed that the movement through stage categories was differentiated by both the strenuous and moderate frequency indicators. However, these researchers did not include follow-up comparisons of individual stage means, thus, no comment on the ability of the measure to differentiate the individual stage categories can be made.

Sensitivity and Specificity of the Exercise Stage of Change Measure

As a descriptive exercise, sensitivity and specificity were calculated for the exercise stage of change measure in a manner similar to Lee et al. (1999). Sensitivity was calculated based on the exercise stage of change measure's ability to predict which participants would meet each stage's defined exercise frequency levels indicated by the GLTEQ. The stage measure showed the greatest sensitivity levels in the combined precontemplation-contemplation stage of change (86.7%). The least sensitivity was found for the preparation stage (32.9%).

Specificity was calculated based on the exercise stage of change measure's ability to predict which participants would be excluded from the algorithm's defined exercise frequency levels indicated by the GLTEQ. Greatest specificity values were found for the preparation stage (93.3%), and the lowest for the precontemplation-contemplation stage (72.3%). These findings indicate that the preparation stage of change, relative to the other stages, has a limited ability to identify those who meet the exercise frequency levels set forth in the exercise stage of change definition. This may present a problem in identifying those most in need of exercise interventions (i.e., those inactive, or occasionally active), as the exercise stage of change measure has a high potential for misclassifying these individuals. This is of practical significance as a large portion of the current study's sample is elderly, and as such is quite susceptible to the adverse effects of reduced activity. Stage misclassification could result in these individuals receiving ineffective stage-matched interventions that are not designed for their stage profile, and potentially having them wrongly classified as being at low-risk for sedentariness.

Exercise Stage of Change: Possible Misclassifications

The support for the concurrent validity of the stage of change measure with the well validated GLTEQ suggests that the exercise stage of change measure accurately classifies individuals into the proper stage category. However, sensitivity and specificity data suggest the exercise stage of change measure may be overly conservative when classifying individual into the preparation stage of change. Frequency report data from the GLTEQ suggests a large portion of the individuals who reported being occasional exercisers (i.e., preparation stage) actually did either none, three or greater bouts of exercise per week, or participated in activity below the defined intensity level (i.e., moderate or strenuous). It is noted, however, that the GLTEQ and stage of change measure define exercise in slightly differently ways. The exercise stage of change measure focuses on recall of an exercise pattern, while the GLTEQ specifies a restricted time period (i.e., over the past month). Perhaps recall bias is compounded by the individual remembering a more distant time period for the exercise pattern required for the stage measure.

Exercise Stage of Change Analyses

Analyses of the exercise stage of change across the three time periods supported the hypothesized overall regression in stage occupied from the prediagnosis to during treatment time period. It also revealed a significant progression in stage between the during treatment and posttreatment time period. Analysis of the rates of progression and regression of stage between the prediagnosis and posttreatment time period suggest that while significant stage change did occur for individual participants, the overall stage advancement was balanced by overall stage regression in this sample. An additional comparison of active stage (i.e., action, maintenance) membership suggests that while stage changes occurred for individuals, when viewed across the entire sample, equal numbers of individuals exist in the active stages at prediagnosis and posttreatment time periods.

This fails to support prior literature (Courneya et al., 1999b; Courneya & Friedenreich, 1997b, 1997c; Cooper, 1995; Keats & Courneya, in press) which suggests that the cancer experience has a negative effect on exercise levels. Alternately, analysis of the prediagnosis and posttreatment stage of change profiles actually suggests that a meaningful progression between precontemplation and contemplation occurred for 14 of the 20 individuals across the cancer experience. This finding seems to suggest that it has served as a catalyst to the serious consideration of exercise for these individuals. Although lesser numbers were in the most advanced stage (i.e., maintenance) in the posttreatment time period, this profile was balanced by higher numbers in the action stage. Arguably, stage movement from precontemplation to contemplation (i.e., beginning serious consideration of regular exercise) is the most important step in the promotion of regular exercise behaviors, outweighing in practical significance the decreased risk of behavior relapse found when moving from the action to maintenance stage.

A comparison between the activity levels of this breast cancer sample and an age-matched sample from the general Alberta population was undertaken. Cross-sectional analysis of exercise stage of change frequency data indicate that 42.1% of breast cancer survivors were active, while 57.9% were inactive, or occasionally active. Mean age of study participants was 52.3, which yielded a comparable exercise stage of change distribution to a 40 through 54 years of age grouping from the broader Alberta population

(Mummery & Spence, 1998). This study found a 45.0% active and 54.9% inactive, or occasionally active rate. This finding suggests that activity rates do not significantly differ between breast cancer survivors (mean of 20.2 months postdiagnosis), and a sample from the general population of Alberta. Notably, the Alberta sample's stage measure evaluated vigorous physical activity, as opposed to the more stringent criteria of moderate and strenuous exercise in this breast cancer survivor sample. This suggests that this breast cancer sample is likely to be at least, or potentially even more active, than the age-comparable general population of Alberta.

A longitudinal analysis of the stage of change at different time periods after cancer diagnosis, not only a cross-sectional view at an average of 20.2 months afterwards, is needed. While this study's findings suggest stage membership numbers approximated those held prediagnosis, without longitudinal assessments of exercise stage of change, it cannot be determined whether this return was almost immediate, or took the entire 20.2 months. If it is found that it took the entire time to return, this would provide support for the need of exercise interventions in this population.

The culmination of these findings appear to suggest that while absolute numbers in inactive and active stages do not radically change from prediagnosis to a time point 20.2 months after cancer diagnosis, a significant shuffling does occur in exercise stage of change for individuals. This study proposes that an individual's pattern of exercise stage change across the cancer experience may be more important than the population's stage of change profile. These shifting patterns suggest that some breast cancer survivors have gone from active to inactive, while others have used the cancer experience as a catalyst to beginning exercise. This has important implications because prior research has shown (Courneya et al., 1999b; Courneya & Friedenreich, 1997b, 1997c; Cooper, 1995; Keats & Courneya, in press) that individuals that were active before cancer diagnosis, and do not return to activity after treatment, are very likely to suffer QOL decrements.

Exercise Stage of Change Measure Advantages Over Exercise Frequency Indicators

The findings of this study suggest that the absolute numbers of individuals in different stages changes across the cancer experience. Those researchers who have previously failed to show the return of exercise behaviors across the cancer experience (Courneya et al., 1999b; Courneya & Friedenreich, 1997b, 1997c; Cooper, 1995; Keats & Courneya, in press) have utilized frequency indicators. In the exercise stage of change measure, one's frequency of exercise is interpreted as being within a specified range which subsequently classifies the individual into a limited number of stages. This study suggests that the exercise stage of change may be a more appropriate measure than exercise frequency for analysing exercise behavior patterns. This is because exercise stage of change definitions include cut-points put forth by American College of Sports Medicine (1998) that are related to the health benefits of physical exercise. For example, the difference between one and three sessions of exercise per week is more meaningful for health than the difference between four and six. However, caution is suggested as only exercise frequency and its relation to QOL has been studied empirically.

Transtheoretical Model Variable Analyses

The preliminary analysis of the study data (MANOVA followed by univariate F and Tukey post hoc tests) revealed findings that for the most part failed to support those of the general exercise and TTM literature (e.g., Buxton et al, 1996; Cardinal, 1995b; Marcus & Simkin, 1994; Prochaska & Marcus, 1994). Even though all TTM variables, with the exception of dramatic relief, reliably distinguished at least one stage from another, none were associated with exercise stage of change exactly as per hypotheses. Trends toward the relationship suggested by the individual hypotheses were often found, but often a multifaceted hypothesis was only partially supported.

Processes of Change Analyses

Consistent with previous findings (e.g., Buxton et al., 1996; Cardinal, 1995a; Marcus & Simkin, 1994; Prochaska & Marcus, 1994), those in the precontemplation stage used the processes of change significantly less than in other stages suggesting this group has a lesser concern for any possible negative effects of their inactivity. However, counter to hypothesis, cognitive process use then increased in the contemplation stage and remained constant through until maintenance, with no further stages being discriminated. Behavioral process use did show a continuous increase from precontemplation through action stages, however, counter to hypothesis, it continued to increase through maintenance. The two inactive stages (i.e., precontemplation and contemplation) were significantly differentiated from the occasionally active (i.e., preparation), which in turn differed from the active stages (i.e., action and maintenance).

The trends in processes use seem to suggest that breast cancer survivors require an increasing use of cognitive and behavioral techniques to maintain exercise behavior over time. This finding is inconsistent with those in healthy adult samples (e.g., Buxton et al., 1996; Cardinal, 1995a; Marcus & Simkin, 1994; Prochaska & Marcus, 1994) which show a decrease in the use of cognitive processes in the maintenance stage, and a levelling off of behavioral processes use in that stage. This finding suggests that continued vigilance in providing interventions that encourage both the learning and increased use of cognitive and behavioral strategies and techniques may be needed for breast cancer survivors. However, future research will want to evaluate exercise stage of change assessment at periods longer than the mean of 20.2 months postdiagnosis found in this study. Perhaps as the mean number of months postsurgery increases, the processes of change use may reflect that commonly shown in other samples using the TTM (Buxton et al., 1996; Cardinal, 1995a; Marcus & Simkin, 1994; Prochaska & Marcus, 1994).

Self-Efficacy Analyses

Self-efficacy was found to increase linearly across the stages, but only after the contemplation stage. Only the action and maintenance stages were significantly differentiated by the construct. These findings lend support to the concept of the importance of the self-efficacy construct in late stage transitions, as suggested by DiClemente et al. (1991). Precontemplation members reported a mean self-efficacy score equal to that of those in preparation. Precontemplation contains individuals that are uninformed about the long-term effects of their behavior, or are demoralized about their ability and do not want to think about change. They may even be defensive, due in part to social pressures to change (Prochaska & Marcus, 1993). It is reasonable to assume that many of these individuals may have not undergone serious consideration of, or ever endured the factors which may have a negative effect on their ability to exercise. These factors may not have allowed for a reasonable evaluation of their exercise self-efficacy.

Also, the small number of individuals in the precontemplation stage (i.e., $\underline{n} = 9$) may not have been representative of the population.

Decisional Balance Analyses

The hypothesized increasing linear relationship was not well represented in the pros construct across the stages of change. Counter to the hypothesis, the contemplation stage revealed a higher mean than both the preparation and action stages. The only adjacent stages to be differentiated by the pros measure were precontemplation and contemplation, even despite the small sample size in the precontemplation stage (i.e., $\underline{n} = 9$). The only non-adjacent stages differentiated were preparation from maintenance, and precontemplation from preparation, action, and maintenance. Practically this suggests that to get breast cancer survivors to seriously consider a change requires that they view the pros of exercise as significantly greater than those who are not considering it. This suggests that an intervention aimed at increasing knowledge of the pros for exercise may be effective in getting those not considering exercise to give it serious consideration. Additionally, meaningful differences did occur in the more advanced stages, and as such interventions aimed at increasing incentives for individuals in these stages may also be effective.

The measure of cons did not reveal the decreasing linear relationship that was hypothesized. Slightly greater values were found in the contemplation and preparation stages, and slightly lower values in the precontemplation, action and maintenance stages. Moreover, cons revealed little overall variability across the stages, and no adjacent stages were discriminated. The only statistically significant decrease in cons was between the preparation and maintenance stages. Practically, these finding suggest that to get an individual to go from making small changes in their exercise behavior to being one who can maintain regular exerciser for longer than six months, they will have to report fewer cons to that exercise. Thus, interventions focussed at decreasing the cons to exercise between the preparation and maintenance stages may be effective.

The lack of the pros and cons ability to consistently discriminate the three initial stages of change (i.e., precontemplation, contemplation, and preparation) contradicts previous theoretical and empirical research (DiClemente et al., 1991). One possible explanation is that perhaps the individual pro and con item's relevance to breast cancer survivors is lacking. However, because the decisional balance measure has: (a) been developed specifically for exercise (Marcus, Rakowski, et al., 1992) and subsequently validated in samples from numerous populations (e.g., Cardinal, 1995a; Marcus & Simkin, 1994; Prochaska & Marcus, 1994), (b) selected its additional pro items from previous breast cancer research, and (c) failed to reveal any concerns in an analysis of the individual items, this is probably not the case.

Perhaps the inability to discriminate the initial stages was because of the small sample sizes in precontemplation (i.e., n = 9), contemplation (i.e., n = 21), and action (i.e., n = 16) stages. The ability to detect meaningful differences between these stages may have been impaired by statistical power concerns, or these small samples may not have been representative of the larger population. This finding is inconsistent with that of previous TTM and exercise research (e.g., Buxton et al, 1996; Cardinal, 1995a; Marcus & Simkin, 1994; Prochaska & Marcus, 1994). Further replication of this study's findings are needed to establish if this finding is indeed unique to breast cancer survivors.

Pro-Con Crossover

Most studies in the exercise domain have examined the pro-con crossover point using standard metric T-scores. This crossover has been found at the action stage for adolescents (Nigg & Courneya, 1998), between preparation and action in older adults (Gorely & Gordon, 1995), in preparation for middle-aged adults (Marcus & Owen, 1992; Marcus, Rossi, et al., 1992), and in contemplation for an Australian middle-aged adult sample (Marcus & Owen, 1992). In the current study, the analyses suggests the crossover point occurred in the action stage of change. The variability between the stated location of the pro-con crossover in previous empirical findings suggests that possibly a problem may exist with the constructs, their measurement, or it may in fact reflect true differences between populations.

The use of the raw scores was considered the more appropriate technique for establishing the pro-con crossover. Analysis of raw scores has practical advantages over the metric T-scores, such as allowing for practical comparisons to be made between pros and cons values. For example, if the mean of the pros are close to their maximum values across the stages, it would not be wise to attempt to increase them further. An additional problem with T-scores is that they allow the small numbers of individual responses in the precontemplation and contemplation stages to be given relatively less weight. This is because the larger numbers of individuals in the more advanced stages draw the sample pros and cons means closer to their stage mean, and consequently the crossover point closer to them (Nigg & Courneya, 1998).

Through utilizing raw scores, Nigg and Courneya (1998) found this crossover point at the precontemplation stage, and this finding was replicated by the current study. The location of the pro-con crossover in the precontemplation stage suggests the balance of the pros and cons constructs may be an important decisional element in whether postsurgical breast cancer survivors initiate exercise behavior, this supporting predictions from Janis and Mann's (1968, 1977) decisional balance theory. The balance of the pros and cons is considered to be important because it is assumed that when one's relative rating of the pros of exercise exceeds the cons of that activity, one will be much more likely to initiate the behavior. Because this crossover occurs at the precontemplation stage, and a statistically significant positive difference exists between the pros and cons means at the adjacent contemplation stage, it suggests that as the pros out-weight the cons of exercise, an individual then gives serious consideration to initiating exercise.

Exploratory Analyses of a Possible Structured TTM Variable Relationships

An analyses of the social-cognitive construct's possible mediational role in the relationship between the processes and the stages of change variables revealed little support for this premise. Forced entry of the processes of change into a regression equation after the entry of the social-cognitive constructs drastically altered the relationship of the social-cognitive variables to the stage variable. This finding suggests that there is a direct relationship between the processes of change and stage. Standardized regression coefficients showed significant direct relationships for environmental reevaluation, reinforcement management and counterconditioning. Thus, 7 of the 10 processes provided no additional explanatory power in the stage of change construct.

Courneya and Bobick (1999) tested the mediational role of the TPB variables for the processes and stages of change. They suggest the TPB has been better validated than the TTM for explaining why exercise behavior changes. The TPB variables (i.e., attitude, subjective norm, perceived behavioral control, and intention) replaced the corresponding variables of the TTM (i.e., self-efficacy, pros, and cons). Counter to hypothesis, only 8 of 10 processes of change were mediated by the TPB's social-cognitive constructs. Counterconditioning and environmental reevaluation explained a significant amount of variance beyond the social-cognitive constructs.

Courneya and Bobick (1999), along with the findings of the present study, support a direct relationship between counterconditioning and stage of change. Counterconditioning is defined as the substitution of alternative behaviors for the problem behavior (Prochaska et al., 1994). As an example, one of the four counterconditioning items is, "instead of remaining inactive, I engage in some physical activity". The present study supports the premise by Courneya and Bobick (1999), that this definition is similar to a self-report of activity, and as such should have a strong correlation with exercise behavior when presented together. However, the direct effect of reinforcement management on stage could not be explained.

In the current study, as in Courneya and Bobick (1999), environmental reevaluation also held a more meaningful relationship with stage, however, the standardized regression coefficient revealed it to be least significant of the three. It is defined as consideration and assessment of how the problem effects the physical and social environments (Marcus, Rossi, et al., 1992; Marcus, Banspach, et al., 1992). It is suggested that the environmental reevaluation process of change is a measure of an individual's social influence on those around them, and it highlights the importance of a social construct which is lacking in the TTM. Even though Courneya and Bobick (1999) did find a direct influence of the environmental reevaluation while using the TPB which contains a social construct (i.e., subjective norm), it only considers social factors as one-way, with the social environment influencing the individual. Future research may care to consider a measure of social influence which includes the complexity of the social interaction by acknowledging its two-way influence.

In further analyses of the current data set, the significant social-cognitive variables from the first analysis were subsequently regressed on the individual processes of change. For the self-efficacy construct, the only significant relationships identified were for consciousness raising, self-reevaluation and self-liberation. This suggests that only these three processes of change are significantly related to the self-efficacy construct. Regression of the pros measure on the processes of change identified self-reevaluation and counterconditioning as the only variables to explain significant variance. Taken as a whole, these findings suggest that a relationship among the TTM variables suggested by Courneya, Nigg et al. (1997), may not be an effective descriptor of the relationship amongst the TTM variables in breast cancer survivors.

Study Scope and Potential Biases

Care must be taken when interpreting study results as only a limited range of time elapsed since diagnosis was evaluated. Generalizing results to those well beyond cancer diagnosis (e.g., greater than three years), or to those who are presently undergoing cancer treatment, may be in error. Limitations of this study include an overrepresentation of participants in the less advanced stages of cancer. This suggests that participants who have better prognoses, and are undergoing less severe treatment protocols with a curative focus, were more likely to participate. However, this is not considered problematic as these individuals are most likely to have the functional ability to exercise, more so than those receiving palliative care which focuses more on pain control.

Selection bias is acknowledged as the 58.3% response rate certainly yielded a more interested and physically active sample. Further, issues of social desirability must be considered when interpreting subjective exercise data, as well as the TTM variable data, which are all through self-report means. In North American society exercise is promoted as a healthy lifestyle choice, and participants may have been influenced by a tendency towards reporting greater activity ratings and stronger beliefs about exercise.

Further, recall bias is acknowledged as a potential problem in the retrospective exercise stage of change assessments (i.e., prediagnosis and during treatment time periods), and to a lesser degree the cross-sectional assessment, used in this study. Also, a further issue is that a self-report measure (i.e, GLTEQ) was used to validate a second self-report measure (i.e., exercise stage of change) in this study. This concern may warrant additional research that validates the stage measure with more objective measures of exercise.

Another concern is that of the small sample size in two of the stages (i.e., 5.1% in precontemplation, and 9.0% in action) may not have allowed the statistical power to detect significant differences in TTM variables for these stages (Cohen, 1995). This is evidenced in the fact that large, medium, or small effect sizes were found for all TTM variables except dramatic relief, cons, environmental reevaluation and stimulus control, however, very few stage transitions were identified as statistically significant. Because the stage of change portions in this sample were not beyond the norm for TTM research from other populations, it is recommended that larger samples and stratified sampling techniques be included in future research.

Future Directions

The breast cancer experience has an effect on the stage of change distribution during cancer treatment, however, the sample's postdiagnosis stage profile suggests it returns to approximate that found for the prediagnosis time period. Certainly, future research aimed at evaluating the time taken for stage membership numbers to return to prediagnosis levels is needed. This has practical implications as the longer it takes (e.g. 4 versus 18 months) to return to prediagnosis exercise stage of change, the more important exercise interventions may be to reduce the negative effects of this reduced activity.

A number of additional analyses may be considered in future research with breast cancer survivors. These include a discriminant function analyses, which would follow the multivariate analyses in the current study. These analyses would allow for the identification of the significant and independent predictors of stage, which in turn may help yield a more parsimonious model. Further, exploratory analyses concerning the unique determinants of each individual adjacent stage changes would be also be interesting additional analyses. This approach would allow the exploration of the unique predictors for the individual stages which is one of the underlying rationales for a stage model of behavior change (Courneya & Bobick, 1999). Further, research is needed that uses prospective designs to evaluate the predictability of the TTM over time, as well as additional studies to test the effectiveness of TTM-structured interventions in breast cancer survivor samples.

Also requiring additional research is the appropriateness of an reciprocal social construct, consideration of a modified staging algorithm for the preparation stage, and further study of the pro-con crossover location and its interpretation. Additionally, further research on the advantages of T-scores versus raw scores, a search for a more parsimonious model with fewer predictors, and the specifying of the interrelationships between TTM variables, is also needed.

Conclusion

As a whole, the TTM performed only moderately well in explaining exercise stage of change in a breast cancer survivor sample. While a large number of hypotheses were put forth based on reviews of prior TTM and exercise literature, often only partial support for multifaceted hypotheses was found. When taken together these findings suggest the TTM may be of limited use in the understanding of exercise motivation and in the design of exercise interventions in breast cancer survivors. Even though some of TTM's problems may be alleviated by larger sample sizes, exercise behavior in breast cancer survivors may be better explained using alternate theoretical models.

Regardless, the stages of change remain a well-validated portion on the TTM. The TTM's social-cognitive variables and processes of change have been researched to a much lesser degree. Perhaps research using alternate theoretical models, such as the TPB, may offer better social-cognitive explanations of exercise stage of change. Preliminary research has shown success utilizing the TPB in an attempt to better explain the stages of change (e.g., Lee, 1993; Nguyen, Potvin, & Otis, 1997; Courneya, 1995b; Courneya et al., 1997; Courneya et al., 1998). Additionally, Courneya and Bobick (1999) have attempted an integration of the TPB with the processes of change.

Currently, the study of the psycho-social determinants of exercise in cancer survivors is in its genesis. More research is needed before any definitive conclusions about the TTM, or any model of exercise behavior change in breast cancer survivor populations, can be made. Because of the empirical support for the advantages of exercise for QOL in this population, it is recommended that further research begin looking at a number of different models of exercise behavior change. This is important as one of these models may allow a more comprehensive understanding of the determinants of exercise, and concurrently assist in structuring the most effective interventions aimed at promoting its initiation and maintenance in breast cancer survivors.

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Appendix A

Quality of Life and Exercise After a Diagnosis of Breast Cancer: Empirical Review

A literature review was performed using the following databases: PsychINFO 1984 through April 1999; ERIC 1966 through March 1999; HeathSTAR 1975 through April 1999; Medline 1966 through the present; SPORT Discus 1975 through September 1998; and Heracles 1975 through 1997. Keywords used in the search were: quality of life, physical exercise, physical activity, and breast cancer. A total of fourteen items were found (Winningham, 1983; MacVicar & Winningham, 1986; Winningham & MacVicar, 1988; MacVicar, Winningham, & Nickel, 1989; Winningham, MacVicar, Bondac, Anderson, & Minton, 1989; Nelson, 1991; Young-McCaughan & Sexton, 1991; Mock et al., 1994; Nieman et al., 1995; Baldwin & Courneya, 1997; Bremer, Bourbon, Hess, & Bremer (1997); Mock et al., 1997; Courneya & Friedenreich, 1997b; Courneya et al., 1999a)

The first study to address QOL issues in breast cancer patients was Winningham (1983). The study's purpose was to determine whether stage II (i.e., mild regional tumor spread) breast cancer patients, while concurrently undergoing chemotherapy, would benefit physiologically and psychologically from a supervised aerobic exercise program when compared to breast cancer patients not in the program. Further, the issue of whether those results would be similar to those of healthy (i.e., without cancer) women undergoing the same exercise protocol, was addressed. Eight breast cancer survivors and four healthy controls were evaluated in this quasi-experimental study. The supervised graded cycle-ergometer program involved a three times per week, for 20 to 30 min, at 60 to 85% of maximum heart rate protocol.

Improvements in functional capacity were found for both the breast cancer and healthy controls, as compared to the non-exercising cancer patients. These gains were parallel and equal for healthy and breast cancer group members. Further, the Multidimensional Health Locus of Control (McNair, Lorr, & Droppleman, 1971) revealed increases in internal locus of control for the cancer experimental group over the non-exercising cancer group. This premier study lent support to the premise that functional capacity improvements in response to aerobic exercise are possible to achieve while receiving adjuvant chemotherapy. Limitations of this study include its small sample size, and that its findings are limited to patients with breast cancer following this specific aerobic exercise protocol. Further, refinement of both exercise parameters and outcome measures were suggested as possible improvements.

MacVicar and Winningham (1986) evaluated 10 breast cancer patients (i.e., 6 exercising and 4 non-exercising patient controls) concurrently undergoing chemotherapy, as well as 6 healthy exercising age-matched controls. This quasi-experimental intervention consisted of a 3 times per week, over 10 consecutive weeks exercise protocol, performed at 60 to 85% of maximum heart rate. Pretest and posttest measures of functional capacity (i.e., cycle ergometer tests) revealed improvements, as did measures of mood disturbance (i.e., Profile of Mood States; McNair et al., 1971) for both exercising groups, while the cancer patient non-exerciser group actually showed the opposite trend. Study limitations identified are similar to the previous study by Winningham (1983).

Winningham and MacVicar (1988) evaluated 42 stage II breast cancer patients with an outcome measure of nausea which was assessed by the somatization scale of the Derogatis Symptom Checklist-90-R (Derogatis, 1977). A cancer-exercising, a cancer-non-exercising control (i.e.,receiving sham treatment consisting of mild flexibility work and conversation), and healthy-exercising group were created in this pretest-posttest design. Subjects were matched for age, height and bodyweight. The experimental intervention consisted of a supervised three times a week, over 10 weeks, cycle-ergometer protocol at 60 to 85% of maximum heart rate, which was performed while the individual was concurrently undergoing chemotherapy. The cancer-exercising group showed decreases in nausea to a larger extent than the non-exercising control group. Possible study limitations suggested are similar to those of the previous studies by Winningham (1983), and MacVicar and Winningham (1986).

MacVicar et al. (1989) studied the effect of aerobic interval training on chemotherapy-receiving stage II cancer patients' functional capacity. Forty-five women entered a supervised and graded exercise program using a cycle-ergometer with a three times per week, over 10 weeks, at 60 to 85% of maximum heart rate protocol. Three groups were created (i.e., exercising, placebo, and control) and assignment was performed in a manner similar to Winningham and MacVicar (1988). The experimental group revealed increases in functional capacity as opposed to both the placebo and control groups. Limitations identified include the homogeneity of the sample, lack of the generalizability of results beyond this study, and the small sample size.

Winningham et al. (1989) investigated 24 stage II breast cancer patients who were receiving chemotherapy. The effects of an exercise program on body-fat percentages and lean body mass indicators were noted. The design used was a pretest-posttest design utilizing a control, placebo and experimental group. Subjects were originally stratified according to functional capacity and then randomized. The protocol consisted of a supervised three times a week, for 20 to 30 min, at 60 to 85% of maximum heart rate for the duration of the 10 to 12 week program. Body-fat was assessed by skinfold caliper measurements. The experimental group showed an increase in lean body mass and a subsequent decrease in body fat as compared to both the placebo and control groups. Data suggest that aerobic exercise may potentially be used to stabilize weight, and reduce body fat percentages in breast cancer patients. Limitations identified include the small sample size, uncontrolled chemotherapy protocols, and the lack of measured dietary intake.

Nelson (1991) studied 55 stage I (i.e., local tumor with no metastases) breast cancer survivors not receiving adjuvant therapy, and 55 age- and family income-matched controls on measures including the Rosenberg (1965) Self-Esteem Scale, a one-item perceived health scale, self-report exercise, and the Health Promoting Lifestyle Profile (Walker et al., 1987). No differences were found for perceived health, self-esteem, and health-promoting behavior. However, differences on the reported benefits and barriers to exercise were found between groups.

In the breast cancer group, women who reported more health-promoting behaviors, such as walking, stretching, and aerobics reported higher self-esteem. The author suggests that survivors of cancer who had more health education and who practiced health-promoting behaviors felt better about themselves, and in turn may have felt more in control of their lives. It was concluded that health-promoting behaviors may not only assist in the early detection of recurrent disease or reduce the risk of secondary malignancies, they may also provide the individual with an increased sense of control. Study limitations include the sample being composed predominantly of stage I breast cancer survivors who were within five years of diagnosis, thus limiting the scope. Further, refusal rate was near 45%, which may have induced a selection bias.

Young-McCaughan and Sexton (1991) compared a group of 42 exercising and 29 non-exercising breast cancer survivors (87% stages I and II), in a correlational retrospective mail-delivered study. Self-report assessments of exercise behavior were through an instrument developed by the authors. These women identified activities performed and how often they engaged in those activities before and after cancer diagnosis. Activities were classified as exercise, pastimes, or chores based on American College of Sports Medicine (1986) guidelines. The Quality of Life Index for patients with cancer (Padilla et al., 1983) evaluated the areas of general physical conditioning, normalcy of daily activities, and personal attributes related to QOL. Findings revealed regular exercisers reported significantly higher QOL than the non-exercising breast cancer survivor controls.

Limitations noted in this study included the small sample size, homogeneous sample composition (i.e., Caucasian and upper-class), retrospective design, self-report exercise measures, possible selection biases, and lack of accurate evaluation of the intensity and duration components of exercise. In response to the support for the individual barrier of not having an exercise partner that was identified, the authors suggest organizing groups of breast cancer survivors so that they could provide group support for participating in exercise endeavours.

Mock et al. (1994) had 14 stage I and II breast cancer patients, who were concurrently receiving chemotherapy, report their exercise behaviors while completing a home-based exercise intervention. The program consisted of a 10 to 45 min self-paced walk, four or five times a week, while concurrently undergoing a four to six month chemotherapy treatment protocol, and attending structured support group meetings. Measures of physical functioning were through the 12 min walk test (McGavin, Gupta, & McHardy, 1976), psychosocial adjustment was measured by the Psychosocial Adjustment to Illness Scale (Derogatis & Lopez, 1983), and the Brief Symptom Inventory (Derogatis &

Spencer, 1982). Self-concept was measured by the Tennessee Self-Concept Scale (Roid & Fitts, 1988), body image by the Body Image Visual Analogue Scale (Mock, 1993), and symptoms by the Symptom Assessment Scales (Sutherland, Walker, & Till, 1988). Assessments were performed prior to treatment, at mid-treatment, and at the completion of treatment.

Self-report diaries of exercise sessions, which included indicators of heart rate as well as subjective data, were kept by each subject. Performance data on the 12 min walk test were recorded at pre-, mid-, and post-intervention. The experimental group increased performance, while the non-exercise program women actually decreased their performance. Significant differences between groups on the variables of fatigue, anxiety, depression, and body dissatisfaction, at both the mid- and end-points, was found. Limitations include the small sample size and convenience nature of participant recruitment. Further, the design of the intervention did not allow for the clear attribution of effects to either the exercise or group support sessions.

Nieman et al. (1995) conducted an experimental study on 12 breast cancer survivors (no stage characteristics reported) who were not presently receiving chemotherapy or radiotherapy. This pretest-posttest study included a treadmill test (i.e., dependent measure being heart rate), six min walk, leg extension strength, and blood tests for immune cell (NKCA) levels. Subjects were randomly assigned to either an exercise or sedentary control group. A supervised weight training and walking program was implemented, which encompassed an eight week period, performed at 75% of maximum heart rate, three times a week, for 60 min per session. The experimental group revealed improvements on the six min walk test, the leg strength test, and heart rate indicators as compared to the non-exercise controls. No differences were found for the blood immune cell levels. Limitations noted include the small sample size and the short experimental time period. Also, high initial baseline differences on the measured variables, including immune cell levels were found between groups.

Baldwin and Courneya (1997) evaluated 64 breast cancer support group volunteers (64% stage I or II) from two different cities, of which 33% were in active chemotherapy or radiation treatments. This correlational study involved self-report of exercise by the GLTEQ. Outcome measures of self-esteem were assessed by the Rosenberg Self-Esteem Scale (Rosenberg, 1965), physical acceptance by the Body Image Visual Analogue Scale for cancer patients (Mock, 1993), and physical competence by the Physical Self-Efficacy Scale (Ryckman, Robbins, Thornton, & Cantrell,1982). Findings revealed that strenuous exercise was significantly correlated with measures of self-esteem and physical competence.

Limitations include self-report indicators that may have induced social desirability and self-presentation biases. Second, the lack of generalizability because of convenience sampling was identified. Lastly, an assessment of the long-term impact of exercise on self-esteem, physical acceptance, and physical competence would be desirable.

Bremer et al. (1997) studied 90 female South African breast cancer survivors (stage not reported) in a correlational study. Measures of psychological adjustment were taken by the Affect Balance Scale (Bradburn, 1969) and Index of Well-Being (Campbell, Converse, & Rodgers, 1976). Further, health locus of control was assessed by the Multidimensional Health Locus of Control measure (Wallston, Wallston, & DeVellis, 1978). Exercise behavior was assessed by a non-identified instrument. Internal locus of control and positive adjustment were not found to be related to regular exercise. The authors suggest the greater than average mean elapsed time since surgery found in this study could partially explain the non-coherence of these results with those studies that preceded it. Most previous studies have assessed exercise in the first few months after surgery. This study suggests that perhaps these variables are less important in the maintenance of exercise over time.

Courneya and Friedenreich (1997c) assessed QOL among 167 breast cancer survivors (87% stages I and II). This correlational study evaluated self-reports of exercise using the GLTEQ at three time-periods (i.e., prediagnosis, active treatment, and posttreatment). Also at posttreatment, measures of QOL (Functional Assessment of Cancer Therapy - Breast; Cella et al., 1993) and satisfaction with life (Satisfaction with Life Scale; Diener, Emmons, Larsen, & Griffin, 1985) were presented. Exercise during active treatment was associated with higher QOL and overall satisfaction with life. Also, the maintenance of exercise across the three time periods was the optimal pattern for enhanced QOL and overall satisfaction with life.

Limitations include the retrospective (i.e., recall of behavior up to two years prior) and correlational design type (i.e., women reporting higher QOL may actually be more willing to exercise), used in this study. Also, QOL was only assessed after treatment, thus support for the role of exercise during treatment cannot be made. Lastly, the effect of specific therapy protocols was not considered, nor were other factors which may affect QOL controlled for (e.g., concurrent psychological counselling).

Mock et al. (1997) evaluated 46 stage I and II breast cancer patients in an experimental intervention. It consisted of a home-based progressive walking program for between 20 and 30 min, between four and five times a week, concurrent with radiotherapy. Measures of functional capacity were performed through the 12 min walk test (McGavin et al., 1976), and symptom experience was measured by the Symptom Assessment Scale

(Sutherland et al., 1988).

The experimental group revealed significantly higher functional capacity, and less anxiety and sleep problems than non-exercising controls at the completion of the program. Further, fatigue and emotional distress decreased in the exercise group and actually increased in the control group. Exercisers also reported significantly higher levels of satisfaction with their bodies. Limitations include the lack of control that was possible over the participant's vigilance in the exercise program, and the self-report method of assessing exercise. However, it was suggested that each subject adhered completely to the exercise program. Further, while the selection of patients was random (i.e., alternating between patients at two separate medical centres), demographics showed an over-representation of higher educated women in the exercise group.

Courneya et al. (1999a) used a prospective design to examine the relationship between exercise and QOL in 53 postsurgical colorectal cancer patients. Self-report QOL questionnaires were completed at two months postsurgery, after which they had their exercise behavior monitored for the subsequent four month period. They then completed a final QOL questionnaire after this period. Functional QOL was the least possessed but most important dimension underlying overall satisfaction with life. Changes in mild exercise from prediagnosis to post surgery correlated positively with QOL at four-months follow-up, and with changes in QOL from baseline to follow-up. The authors concluded that changes in mild exercise from prediagnosis to postsurgery are positively associated with QOL in colorectal cancer patients.

Appendix B

Exercise Determinants in Cancer Survivors: Empirical Review

A literature review was performed using the following databases: PsychINFO 1984 through April 1999; ERIC 1966 through March 1999; HeathSTAR 1975 through April 1999; Medline 1966 through the present; SPORT Discus 1975 through September 1998; and Heracles 1975 through 1997. Keywords used in the search were: psycho-social determinants of exercise, physical exercise, physical activity; and breast cancer. A total of eight items were found (Courneya et al., 1999b; Courneya & Friedenreich, 1997a, 1999; Leddy, 1997; Perna, Spencer, Carver, & LaPerriere, 1997; Cooper, 1995; Young-McCaughan & Sexton, 1991; Nelson, 1991).

Courneya and Friedenreich's (1997a) retrospective (n = 110; 85% stage II or III) and Courneya et al.'s (1999b) prospective study (n = 66; 53% stage I or II; 39% stage III; 8% stage IV) of colorectal cancer survivors, and Courneya and Friedenreich's (1999) retrospective study of a breast cancer survivors (n = 164; stage not identified) were among these studies identified. The retrospective studies provide initial support for the theory of planned behavior as a useful framework for understanding the determinants of exercise after both colorectal and breast cancer treatments. Further, the findings of the colorectal longitudinal study (Courneya et al., 1999b) were similar to those of its retrospective predecessor (Courneya & Friedenreich, 1997a), lending support to the applicability of the model over time.

Intention and perceived behavioral control were important predictors of exercise behavior in all studies. Courneya and Friedenreich (1997a) and Courneya et al. (1999b) found that intention was determined exclusively by attitude in these colorectal cancer survivor samples. Courneya and Friedenreich's (1999) breast cancer sample revealed an additional significant influence of subjective norm on intention which was not found in the colorectal cancer sample. A notable finding for both samples is that demographic and medical variables did not reveal themselves as meaningful determinants of exercise, and as such their importance in the understanding of exercise motivation is not supported.

Leddy (1997) identified the most important incentives and barriers to exercise in women with breast cancer. First, an exercise scale was developed from the interview data which included a measure of the importance of each incentive and barrier framed after the decisional balance model of decision making (Janis & Mann, 1968; 1977). Sixty-four women who were treated for cancer within the last 10 years were administered the questionnaire.

The Leddy (1997) Incentives and Barriers to Exercise Scale (IBES) sums the scores for all incentive and barrier items separately. Next, the total sum of the barrier score is subtracted from the total sum of the incentive score to yield the decision balance index. On average the incentives slightly outweighed the barriers in this sample of breast cancer survivors. A self-report measure of exercise frequency separated the two groupings of "several or everyday of the week" and "rarely or never" exercisers. The two groups were significantly different from each other on the decisional balance. Further, the decisional balance accurately predicted 83% of those women who exercised regularly from those who did not. This indicates that the IBES could potentially screen individuals at greatest need for exercise-promotion interventions. Limitations of this study include its small sample size and homogenous, middle-class sample.

Perna et al. (1997) studied perceived barriers to exercise in post-surgical breast cancer patients (n = 57; stage not reported). Univariate analysis indicated that caring for children, self-consciousness regarding appearance, discouragement by others, and fear of injury differentiated exercising and non-exercising groups. Specifically, non-exercising mastectomy patients gave the highest perceived barriers rating, and with one exception (i.e., self-consciousness), for which exercising mastectomy patients gave the lowest ratings. Exercising lumpectomy patients gave the lowest ratings for self-consciousness.

Cooper (1995) also studied the role of exercise in recovery from breast cancer. For the 550 questionnaires which were distributed, 75 were returned (participant age M = 49). This survey included questions of the amount and importance of physical activity, how much information was received from one's health care provider, and obstacles faced when becoming physically active after treatment. The sample reported a high level of physical activity (71%), defined as three or four hours a week, before diagnosis. Women who placed a greater importance on exercise reported exercising more. An overall decrease in activity was found between the pre- and post-diagnosis time periods. Respondents who reported being able to return to physical activity within three months after their treatment accounted for 67% of the total sample. Additionally, only 43% expressed any obstacles to returning to physical activity after treatment. Women who noted more obstacles, took longer to become active again.

Young-McCaughan and Sexton (1991) compared a group of 42 exercising and 29 non-exercising women in a retrospective mail-delivered study including an assessment of perceived barriers to exercise through a modified Perceived Barriers to Exercise Scale (PBES; Given, Given, & Gallin, 1983). The exercising group perceived significantly fewer barriers to exercise than the non-exercising group. Approximately 30% of women reported a condition that modified their ability to perform, or their levels of physical activity. Only four individuals noted conditions directly related to cancer that modified their ability to exercise. Limitations noted in this study included the small sample size, homogeneous sample composition (i.e., Caucasian and upper-class), retrospective design, self report exercise, possible selection biases, and a lack of an accurate evaluation of the intensity and duration components of exercise.

Nelson (1991) utilized the health belief model and Rosenberg's self-esteem theory (1965) to structure a mail-out study of exercise determinants in a breast cancer survivor sample (n = 54; modified radical mastectomy survivors who had not received adjuvant therapy), and a group of age- and family income-matched cohorts (n = 54). Perceived health, health habits, self-esteem, and benefits and barriers to exercise were measured. Women who reported performing more health behaviors also reported more benefits of exercise. Women who practiced more health promoting behaviors were shown to have higher self-esteem. Study limitations include unequal numbers of non-exercisers between groups, a narrowly defined sample, and the transparent nature of the study.

Appendix C

Exercise Determinants in Cancer Survivors: Empirical Review Table

Authors	Sample	Design	Assessment/Measures	
Courneya et al. (1999b)	66 survivors of colorectal cancer diagnosed between September 1996 and December 1997	Prospective	Exercise behavior and theory of planned behavior variables: behavioral beliefs, control beliefs, normative beliefs, attitude, subjective norm, perceived behavioral control, and intention	- Salient beliefs about exercise were different for patients with colorectal cancer, as compared to healthy individuals - Exercise during cancer treatment was determined by intention and perceived behavioral control. - Intention was determined by attitude alone - Theory of Planned behavior supported in 4 month prospective study
Courneya & Friedenreich (1999)	164 women diagnosed with breast cancer within the previous 2 years	Cross-sectional	Exercise behavior and theory of planned behavior variables: Behavioral beliefs, control beliefs, normative beliefs, attitude, subjective norm, perceived behavioral control, and intention	- Salient beliefs of breast cancer patients concerning exercise were different from those of a healthy sample - Intention and perceived behavioral control were significant determinants of exercise during cancer treatment - Attitude and subjective norm were significant determinants of intention
Courneya & Friedenreich (1997a)	110 survivors of colorectal cancer diagnosed between 1992 and 1995 who had undergone adjuvant therapy	Cross-sectional	Exercise behavior and theory of planned behavior variables: behavioral beliefs, control beliefs, normative beliefs, attitude, subjective norm, perceived behavioral control, and intention	- Salient beliefs about exercise were different for patients with colorectal cancer, as compared to healthy individuals - Exercise during cancer treatment was determined by intention and perceived behavioral control. - Intention was determined by attitude alone
Leddy (1997)	11 in Phase I, & 64 in Phase II - women treated for breast cancer within the past: five years (phase 1); 10 years (phase II)	Cross-sectional	- Incentives and barriers to exercise structured around decisional balance model of decision making - Phase I - to identify incentives and barriers specific to population - Phase II - questionnaire delivery to measure importance of each barrier and incentive (Incentives and Barriers to Exercise Scale; IBES)	- Most important incentives to exercise were expectation of benefit and sense of responsibility - The most important barriers were lack of time and inertia - Mean score on the decisional balance index was +19, with a possible range from -72 to +72. Measured scores ranged from -26 to +57

Cooper (1995)	75 women previously treated for breast cancer	Cross-sectional	- Incentives and barriers to exercise questionnaire	- Most common obstacles to exercise were pain, fatigue and feeling embarrassed - 43% said they experienced no significant obstacles in returning to exercise after treatment - Physical activity counseling and information should be promoted by health care providers as this was an important barrier to exercise in breast cancer recovery
Nelson (1991)	54 women who had modified radical mastectomy	Cross-sectional	- Perceived health, health habits, self-esteem and benefits / barriers to exercise	- Significant differences exist between healthy and income- and age-matched cohorts only on measures of perceived benefits and barriers to exercise
Perna et al. (1997)	57 postsurgical breast cancer patients	Cross-Sectional	- Perceived barriers to exercise	- Caring for children, self-consciousness of appearance, discouragement by others, and fear of injury differentiated exercising and non-exercising groups.
Young-McCaughan & Sexton (1991)	42 exercising and 29 non-exercising women who were treated for breast cancer	Retrospective	- Determination of which demographic, disease, and / or treatment variables differ between women with breast cancer who exercise and those who do not - Analysis of the barriers women with breast cancer experience that influence whether or not they exercise - Perceived Barriers to Exercise Scale (PBES) used to measure barriers	- No differences between groups was found for any demographic, disease, or treatment variable - Women who exercised perceived significantly fewer barriers to exercise

Appendix D

Transtheoretical Model: Empirical Review

A literature review was performed using the following databases: PsychINFO 1984 through April 1999; ERIC 1966 through March 1999; HeathSTAR 1975 through April 1999; Medline 1966 through the present; SPORT Discus 1975 through September 1998; and Heracles 1975 through 1997. Keywords used in the search were: Transtheoretical, stages of change, physical exercise, and physical activity. A total of 46 items were found (Armstrong et al., 1993; Barké & Nicholas, 1990; Bock, Marcus, Rossi, & Redding, 1998; Booth et al., 1993; Buxton, Mercer, Hale, Wyse, & Ashford, 1994; Calfas et al., 1997; Perna et al., 1997; Cardinal, 1995a; 1997a, 1997b; Cardinal & Sachs, 1995; Cardinal et al., 1998; Clarke & Eves, 1997; Cole, Hammond, Leonard, & Fridinger, 1998; Courneya et al., 1997; Courneya et al., 1998; Courneya, 1995a, 1995b; Cowan, Logue, Milo, Britton, & Smuker, 1997; Godin, Desharnais, Valois, & Bradet, 1995; Gorely & Gordon, 1995; Hellman, 1997; Herrick et al., 1997; Jue & Cunningham, 1998; Lee, 1993; Marcus et al., 1998; Marcus, Banspach, et al., 1992; Marcus, Eaton, et al., 1994; Marcus & Owen, 1992; Marcus, Pinto, et al., 1994; Marcus, Rakowski, et al., 1992; Marcus, Rossi, et al., 1992; Marcus, Selby, et al., 1992; Marcus & Simkin, 1993; Marcus et al., 1996; Mullan & Markland, 1997; Mummery & Spence, 1998; Murphy, 1993; Nguyen, Potvin, & Otis, 1997; Nigg & Courneya, 1998; Pinto & Marcus, 1995; Potvin, Gauvin, & Nguyen, 1997; Prochaska et al., 1994; Reed, Velicer, Prochaska, Rossi, & Marcus, 1997; Sonstroem, 1988; Wyse et al., 1995). A chronological review of the TTM will follow.

The initial application of the TTM to exercise (Sonstroem, 1988) studied 220 males over the age of 30 years. Participants were followed over a four-year period after an initial assignment of stage of change based on a self-report exercise history. Nine belief statements regarding outcomes of regular participation in an exercise program, were found to correlate with the exercise stage of change ($\underline{r} = .75$). A 69.9% correct classification rate was reported. However, when participants who reported previous attrition from exercise were included, accuracy decreased to 50.9%. After a reclassification of drop-outs based on future intention to join a exercise program, accuracy was recalculated at 60.3%. It was concluded that drop-outs represented several subsets within individual stages of change, some who intend to and some who do not intend to return to exercise.

These results suggest exercise change may in fact be better understood by viewing change as a process, as opposed to an all-or-nothing phenomenon. The authors stress that the near-exclusive use of static predictive models for studying exercise adherence should shift towards process design types which can examine the relationship of predictor and criterion variables over time.

Barké and Nicholas (1990) studied stage of change among 59 older adults between the ages of 59 and 80 years. In this descriptive study, stage of change was used to examine the stereotype that older individuals are not physically active and have little intention of beginning. Three subgroups of individuals were included: an elderhostel ($\underline{n} = 21$), an exercise participant ($\underline{n} = 18$), and a matched-retiree ($\underline{n} = 20$) sample. The stage of change measure, which dichotomized the individual into either an active or inactive group, was found to distinguish older adult groups. Higher stages were associated with the more active group, and lower stages with those of the lesser active, retiree group. This was offered as a validation of the stage of change construct among elderly individuals. The authors noted threats to external validity including small sample size, representability of the sample, and the descriptive nature of the study.

Marcus, Selby, et al. (1992) developed both stage of change and self-efficacy measures for exercise. Two separate samples ($N_1 = 1063$ government workers; $N_2 = 429$ medical centre employees) were assessed on the stage of change and self-efficacy measures. Mean age for both samples was 41 years, and sex was 77% and 15% male respectively. The stage of change measure was a four-item measure designed to assign subjects to either the precontemplation, contemplation, action, or maintenance stage. A five-point Likert scale was used to rate each item, and the one most strongly endorsed placed that individuals into the corresponding stage of change.

Self-efficacy showed a consistent increasing trend from lower to higher stages, and it significantly differentiated participants at most stages. Proportions of variance accounted for (η^2) were .23 and .28 for the two samples respectively. Internal consistency for the self-efficacy measure was quoted as $\alpha = .76$, and test-retest reliability was $r = .90$. Study weaknesses noted include the use of self-report measures, cross-sectional design, limited generalizability of the sample, as well as the need for further model and instrument development.

Marcus, Rossi, et al. (1992) used a group of 1172 overweight, mostly female, worksite employees (from both a retail outlet and an industrial manufacturer) to develop and cross-validate a process of change questionnaire. Additionally, a revised five-item stage of change measure was delivered (i.e., precontemplation, contemplation, preparation, action, and maintenance). Process of change definitions were modified for exercise behaviors based on the 10 commonly used processes of change found to be utilized across other health behaviors. The sample was split into two, one for instrument development, and the other for the purpose of cross validation.

The pattern of process of change use was found to identify individuals at differing stages of change. Experiential process use was most frequent in the action stage. Behavioral process use increased steadily from precontemplation to action, then stayed constant into the maintenance stage of change. The least total amount of process of change use was at the precontemplation stage. It was concluded that stage of change is effective for classifying exercise behavior change. Also, the processes of change show a significant relationship with the stage variable. The use of self-report measures and cross-sectional design were identified as possible limitations to the study.

With a sample of 778 adult employees from four worksites (66% male), Marcus, Rakowski, et al. (1992) developed a decisional balance questionnaire for exercise. Forty items addressing pros and cons, a decisional balance measure (pros minus cons), as well as a stage of change measure, were delivered to all participants. The final measure consisted of 16 statements, including 6 pros and 10 cons of exercise. An ANOVA reported significant results for the association of pros, cons and the decisional balance measures with the stage of change. Limitations include the use of self-report exercise behaviors (i.e., lack of objective measures of behavior) and cross-sectional design.

Marcus and Owen (1992) studied stage of change, decisional balance and self-efficacy in two different samples (N_1 = 1093 American; N_2 = 801 Australian adult worksite employees). Mean ages for the two samples were 41 and 42 years respectively. Through Tukey post hoc comparisons, self-efficacy and decisional balance indicators were analysed for unique profiles of contribution to the individual stages of change. Self-efficacy revealed a significant relationship with stage of change, with precontemplators and contemplators having the lowest, and maintainers having the highest values. Decisional balance measures also revealed a significant relationship with stage of change. Generally, precontemplators revealed the lowest values on the pro-con index (i.e., indicated more cons than pros), while maintainers had higher values. Differentiation between individual stage of change was not always significant, but hypothesized trends were observed across all stages. Results indicate support for the hypothesized relationship between stage of change and self-efficacy and decisional balance measures.

Marcus, Banspach, et al. (1992) applied TTM constructs in the first community-based, mail-delivered exercise promotion intervention. Six-hundred and ten adults (77% female; 18 through 82 years of age; age M = 42 years) non- and occasional-exercisers received stage-specific packages which included written materials, community activity options, and information regarding organized activity nights. Stage categorization was into preparation, contemplation, or action. Follow-up measures of exercise behavior and self-efficacy were taken after the six-week intervention. A Steward-Maxwell test for correlated proportions revealed subjects were significantly more active after the intervention. This finding was unrelated to gender, education, income or other external factors. The authors identified possible limitations with this premier intervention including the quasi-experimental design, lack of extended follow-up, and lack of validation for survey findings. However, support for the use of the TTM as a framework for an effective exercise intervention was found.

Booth et al. (1993) studied 4044 Australian adults in a nation-wide, randomly sampled, cross-sectional study of stage of change, sociodemographic variables, exercise beliefs, and exercise behavior through door-to-door interviews. Analysis looked at whether self-report exercise beliefs and sociodemographic characteristics of the respondents were associated with their stage of change category. The only significant sociodemographic variable was education level, which reliably associated with stage of change. While there was not a precise correspondence between the stage of change measure and questions dealing with self-report activity levels, the authors concluded the stage of change variable was a useful way to conceptualize exercise behavior.

Marcus and Simkin (1993) tested the concurrent validity of the stage of change construct in 235 male and female worksite employees (age M = 41 years). Based of self-report assessments, subjects were classified into either precontemplation-contemplation, preparation, or action-maintenance. The self-administered seven-day physical activity recall (PAR) questionnaire (Blair, Haskell, et al., 1985; Blair, Collingwood, et al., 1985), which includes indicators of moderate and vigorous physical activity, was used. Through ANOVAs, assessments of stage of change and reports of moderate and vigorous activity were compared. Tukey post hoc comparisons revealed significant differences in participation across the modified stage of change measure. Action-maintenance membership was associated with significantly more moderate and vigorous activity compared to the precontemplation-contemplation group. Additionally, the action-maintenance group significantly differed on amounts of vigorous activity from the preparation stage of change. Support for the differentiation of stage of change was found for the measure of intensity of physical activity.

Murphy (1993) studied the relationship between processes and stage of change within two groups of Australians: an older adult (N = 286; 65 and above years of age); and a presently working group (N = 331; 20 through 64 years of age). Both were studied through a mail-delivered protocol. Analysis of the process of change use across the stage of change, and the subsequent production of a reliable instrument for assessing processes of change was undertaken. Membership in one of the five stages of change was used as the independent variable, and the processes of change from a factor analysis as the dependant variable in an ANOVA to determine differential use of processes of change across the stages of change. Six process of change were found to be consistently used for the working group, and four by the older. Four process of change were shared between the two samples. A MANOVA indicated an overall significant difference between groups existed amongst the six process of change. Six individual ANOVAs were performed and each demonstrated a significant difference between groups for their respective process of change. A series of factor analysis and item reduction steps produced a shortened 26-item version for assessing the six process of change. Reliabilities ranged from $\alpha = .67$ to .91. Additionally, a step-test, exercise history questionnaire, and a exercise intention questionnaire all provided evidence of the construct validity of stage of change construct.

Lee (1993) studied 286 Australian women between 50 and 64 years of age. The relationships between attitudes and opinions, exercise knowledge, preferences and availability, exercise recall, and demographic variables, and stage of change were studied through a telephone interview protocol. MANOVA, ANOVA, and Student Newman-Keuls analyses were used to look at the relationship between stage of change and the aforementioned variables. Exercise knowledge, perceived family support and perceived psychological benefits of exercise distinguished the action group from the precontemplation group. Perceived barriers were significantly different between the contemplation and action groups. They concluded that exercise education could be applied to older women in intervention settings. Additionally, the relationships between stage of change and self-efficacy, family support, self-esteem and social awareness suggest they also may offer potential as intervention target areas. The author suggest stage of change may be useful for developing exercise programs for middle and old-aged women.

Armstrong et al. (1993) studied 401 adults in a two-year, prospective, community-based study. Only individuals in the stages of precontemplation and contemplation were considered. Through a random mail survey, stage of change at baseline was found to be a significant predictor of the adoption of vigorous exercise two years later, even after controlling for age, gender and self-efficacy differences. Self-efficacy also revealed a significant predictive relationship at follow-up. Contemplators were nearly twice as likely to progress to the action stage, and four times more likely to progress to the maintenance stage, then were precontemplators. The model's (i.e., self-efficacy, stage of change) explained variance was 13% at the end of the six-month period. Caution may be required in the interpretation of the findings as the definition of stage of change utilized was framed as an interest in exercise, as opposed to intention to exercise. The authors note the importance of noting that those who are not currently involved in exercise are made up of subgroups which must be identified.

Marcus, Eaton, et al. (1994) evaluated 698 worksite employed adults in a longitudinal study assessing stage of change, self-efficacy, decisional balance and exercise behaviors (i.e., self-administered seven-day PAR). Using a three-step model building approach, exploratory principle component analyses were followed by a review of the model with confirmatory structural equation modelling procedures. Lastly, the model was examined with longitudinal data. Exploratory analysis revealed three independent components (i.e., pros, cons, and self-efficacy). Confirmatory structural equation analysis indicated an excellent fit between the hypothesized model and data (comparative fit index; CFI = .99). Prediction analysis revealed that the model predicted exercise behaviors at six months (CFI = .98). Structural modelling fit indices showed most variation-covariation in exercise was explained by the model. At baseline, exercise intensity level can be significantly predicted by stage of change, pros and cons, and self-efficacy. At follow-up, self-efficacy is strongly related to intention, which was a strong predictor of exercise behavior at six months The authors note more representative samples, and more objective measures of exercise are needed in future studies.

Buxton et al. (1994) evaluated the concurrent validity and measurement reliability of the stage of change variable in a sample of 182 (i.e., 102 male; 80 female) university employees (age M = 38 years). Stepwise discriminant analysis found that the precontemplation-contemplation, preparation, and action-maintenance stages of change were distinguishable. Discriminating variables that were most effective for males were perceived physical conditioning and self-efficacy. For females, perceived physical conditioning, VO_2 peak and very hard activity levels were significant predictors. Classification analysis revealed 66% of males and 67% of females were correctly and significantly classified using prior probabilities. Measurement reliability was confirmed through test-retest correlation for the stage of change instrument (r = .88). The author states that the results tentatively support the concurrent validity and measurement reliability of the stage of change construct.

Marcus, Pinto et al. (1994) assessed stage of change, self-efficacy and decisional balance variables in a cross-sectional study of 431 worksite-employed females. Self-efficacy and decisional balance were found to be significantly related to stage of change membership. MANOVA followed by ANOVA showed those in precontemplation rated the lowest and those in maintenance the highest on self-efficacy, pro and decisional balance indices. The opposite was found for the cons scale. Measures of demographic variables revealed a significant relationship between the presence of both at-home children and marital status, and stage of change occupied.

Prochaska et al. (1994) assessed stage of change and decisional balance constructs in 717 worksite employees. The cross-sectional study found that pro and con indicators were significantly related to the stage of change variable. Cons were found to outnumber pros to the greatest degree at the precontemplation stage, while the opposite was found in the action stage.

Courneya (1995a) investigated the relationship of subjective norm, attitude, perceived behavioral control and intention from the TPB (Ajzen, 1991), to stage of change using 288 older individuals (M = 71 years of age). Moderate to high correlations between the TPB constructs and stage of change were revealed. ANOVA showed significant differences for each TPB construct across the stage of change except for subjective norm (also the least important predictor). Subjective norm, attitude, perceived behavioral control and intention shared variance of 21%, 31%, 29% and 54% respectively with stage of change. Overall explained variance in stage of change was 63%. TPB constructs discriminated all stages of change, except for action from maintenance. Path analysis revealed direct paths from intention, attitude and perceived behavioral control, to stage of change. Additionally, a survey of demographic information showed no relation to stage of change. The author suggests that the TPB may be coupled with the stage of change measure to enhance understandings of beliefs across the stages and that further research into the predictive validity of this model over time is needed.

Courneya (1995b), with a sample of 270 older individuals (60 years of age and above), studied the relationship between the stage of change variable and elements of the perceived severity (PS) concept (i.e., viability, rate of onset, time of onset) from the protection motivation theory (Rogers 1975, 1983; Rogers & Prentice-Dunn, 1997). Via one-way MANOVA, elements of PS were shown to have a significant effect on stage of change. Follow-up ANOVAs showed significant differences for overall PS and visibility. Next, Tukey post hoc comparisons revealed elements of PS separated those in the precontemplation stage from those in the contemplation stage, and that the contemplation stage was not further distinguished from any of the active stages (i.e., preparation, action and maintenance). Further, visibility of disease was the most important dimension of PS. The author suggests that the PS of physical inactivity could be effectively used to motivate people to seriously consider becoming physically active.

Gorely and Gordon (1995) were the first to apply the complete TTM in an examination of the relationship between the stage of change and self-efficacy, decisional balance and process of change. The sample was 583 older Australian adults (50 through 65 years of age). Step-wise discriminant function analysis, which followed a significant MANOVA, revealed that self-reevaluation, consciousness raising, counter conditioning, self-liberation, stimulus control, self-efficacy, pros and cons significantly contributed to the prediction of stage of change. Process of change use varied in complex patterns across stage of change, while pro and con indices varied (i.e., pros increased and cons decreased), and self-efficacy increased linearly with advancing stage of change. The authors noted that across the numerous studies reviewed, the process of change use appears to be similar across different ages and cultures. Limitations noted were the sample selection method and cross-sectional design.

Wyse et al. (1995) examined the utility of stage of change among 244 young British individuals (16 through 21 years of age). Assessments of stage of change, exercise frequency and intensity, BMI, self-efficacy, physical self-perception (i.e., perceived physical conditioning, sports competence, bodily attractiveness and physical strength) and global self-esteem were performed. Significant differences between stage of change were found for measures of self-efficacy, the physical self-perception sub-domains and global self-esteem indicators by one-way ANOVAs. The pattern of significant differences was not found in global self-esteem scores for males and perceived physical strength for females. Those in action-maintenance differed only from those in preparation. Perceptions of bodily attractiveness for females showed no relation to stage of change. Also, males were more likely to be in a higher stages of change, and the GLTEQ elements of moderate and strenuous exercise, as well as the Godin leisure score index, differentiated stage of change for both males and females. This was provided as support for the concurrent validity of the stage of change measure.

Through stepwise discriminant function analysis, two sex-specific functions were found. For males, perceived sports competence and strenuous exercise levels were found in the first function, and self-esteem and bodily attractiveness emerged in the second. For females, the first function contained perceived physical conditioning and strenuous activity, while the second contained perceived sport confidence, perceived bodily attractiveness and perceived physical strength.

Cardinal (1995a) observed 14 adult participants (8 female and 6 male; mean age = 63 years) who evaluated one of two sets of stage of change matched written exercise promotion materials which included both behavioral and cognitive activities. The first, termed the lifestyle exercise package (LEP) promoted exercise as a lifestyle. The second, termed the structured exercise package (SEP) promoted exercise as a structured event, and described exercise via the standard definitions of the American College of Sports Medicine (1991). Eight factors were examined: (a) production quality, (b) content, (c) credibility, (d) attractiveness, (e) ability to convey information, (f) ability to change attitudes, (g) ability to elicit appropriate action, and (h) an overall rating.

No significant differences in the ranking of the two package's ability to be effective in increasing exercise behaviors were found. However, mean scores on the lifestyle materials were lower on all eight factors, and the low statistical power may have affected this result. The authors encourage researchers to use larger and more diverse samples to assess the generalizability of the findings.

Cardinal & Sachs (1995) studied 113 clerical university employed women (age M = 37; 63% African American) in an intervention geared at increasing exercise levels. Subjects were stratified by baseline stage of change, then randomly received one of three mail-delivered, self-instructional, personalized, written exercise packets. The design is similar to Cardinal's (1995a) study, except for the addition of a fitness feedback (i.e., control) condition. Stage of change was assessed pre-intervention and then repeated measures were performed at one and seven months post-intervention. The Fleiss test of proportion revealed the LEP condition as having a lesser chance of dropout, and a McNemar's test of symmetry showed the LEP was most likely to advance stage of change at both one and seven months post-baseline. Interestingly, SEP was less effective than the control group.

Godin et al. (1995) evaluated a sample of 347 adults' stage of change (i.e., five stages represented by habit and intention variations in a three by two matrix), perceived barriers, and social-cognitive theory constructs (i.e., belief-based and global attitude, belief-based and global subjective norm, and perceived behavioral control). Trained interviewers provided baseline construct assessment, and behavior was self-reported at six months. ANOVA revealed a significant difference in exercise behavior between the modified stages of change, which was found to be linear via trend analysis. MANOVA indicated an overall significant difference in the psychosocial variables between stages. Further, pairwise comparisons identified multiple significant differences. Perceived behavioral control was involved in every difference between stages of change, except for stage three (i.e., moderately active with low intention), for which a negative value was found. The authors suggest that stage two (i.e., sedentary with high intention) is a crucial stage because these individuals may have an overly-optimistic view of exercise, and it provides a possible explanation for the 50% dropout rate from exercise programs typically observed during the first three to six months. Interventions targeting to these individuals should highlight true barriers that are common while maintaining optimum levels of activity. The authors conclude that it is appropriate to operationalize stages in terms of past behavior and intention. Again this suggests that there are distinct stages and that adherence to physical activity is a process.

Pinto and Marcus (1995) used a stage of change approach to assist in the understanding of 217 private college student's exercise behavior. Additionally, the relationship of demographic variables (e.g., year of schooling and gender) to stage of change was analysed. Frequency counts were used to assess stage distribution and place of residence (i.e., on or off campus), and chi-square analysis were used for stage of change, gender and year of school variables. Because only the behavioral component of exercise was recorded and data on exercise intention was not available, a modified stage of change measure was used which combined the stages of precontemplation and contemplation. Additionally, because the behavioral assessment contained no information on how long the student had been exercising, classification into the maintenance stage was not possible. Approximately half of the students were inactive or exercising irregularly (i.e., 18% precontemplation-contemplation and 28% in preparation), and the remaining 54% were in the action stage. Gender and year of school were found to be unrelated to stage of change.

Marcus, Simkin, et al. (1996) studied 314 worksite employees (M = 41 years of age; 66% female) in a six-month longitudinal study of the stages and processes of change. Baseline assessments of stage of change and processes of change, and a six-month follow-up behavioral assessment, revealed four distinct patterns of exercise stage of change and process of change use: stable-sedentary, stable-active, adopters and relapsers. MANOVA revealed differences between groups of stable-sedentary and stable-active. Independent t-tests revealed specific differences exist between groups on both specific process of change use, and the numbers of processes used at baseline and follow-up. An overall MANOVA performed on the adopter group was significant, and follow-up univariate analysis revealed that all process of change, except social liberation, increased significantly from baseline to follow-up. MANOVA was also performed on the relapse group and revealed significant results. Univariate tests revealed that all five of the behavioral precesses significantly decreased from baseline to follow-up. Also, the experiential process of dramatic relief reported a significant decrease. These findings suggest it may be beneficial for exercise intervention to use processes of change to effectively maximize exercise initiation and maintenance, and assist in recovery from relapse.

Perna et al. (1997) assessed exercise stage of change along with frequency of aerobic exercise, perceived barriers, and negative affect in breast cancer patients (n = 57; stage I and II) three months past surgury. Approximately 44% of the women reported exercising at least three times a week. Mastectomy patients were more likely to engage in regular exercise than lumpectomy patients (i.e., 71% and 35% respectively). No further analyses were reported on the stage of change variable.

Cowan et al. (1997) assessed exercise stage of change and self-efficacy in a sample of 182 adults recruited from a family practice residency training program. Participants were obese and non-obese primary care patients. Measures of stage of change, self-efficacy, and obesity were made. No significant association between BMI (i.e., high or low) and exercise stage of change was found, however, the finding did approach significance. Obese patients additionally showed no significant differences compared to non-obese in exercise self-efficacy. Self-efficacy scores, however, did differ by stage of change with those in action and maintenance having significantly higher self-efficacy than those in precontemplation.

Cardinal (1997a) used a prospectively-designed evaluation of the contemplation and preparation exercise stages of change in 47 full-time clerical workers (78.7% African American) between 22 and 50 years of age (M = 36.8). Surveys were provided by inter-office mail at baseline, one and seven months post-baseline. Both, the hypothesized higher levels of exercise by those in preparation, and their greater relative movement through the stages was not found. Education, BMI, and initial stage were able to explain a large portion of the variance in stage advancement at one month. At seven months, the only significant predictor was baseline stage.

Cardinal, (1997b) addressed difficulties in prior exercise stage of change research which has used self-report measures exclusively, in a sample of 245 adults. An evaluation of the limitations of these individual measures, and the extension of the current literature through the evaluation of the association among stage of change and BMI, cardiorespiratory fitness, exercise behavior, relapse, barriers, and self-efficacy was performed. This descriptive study found significant between stage differences for the overall set of dependant variables via a one-way MANCOVA (covariates were social desirability and demographic variables). Student-Newman-Keuls post hoc contrasts revealed significant differences for each of the dependant variables separately. Based on Cohen (1992), large effect sizes were observed for VO_2 max, exercise levels, an exercise index, relapse, and self-efficacy. BMI and barriers to exercise had were moderate effect sizes. The proportion of variance accounted for by the dependant variables ranged from .06 to .53. The author concluded that objective support for the stage of change model was gained within the exercise domain. Further, individuals can be classified into exercise stage of change by a number of behavioral, biometrical, and psychological measures, in a way consistent with the theory.

Courneya et al. (1998) applied the TPB to assist in the understanding of stage of change in 147 older individuals over a three-year period. Baseline mail-delivered assessments of the TPB constructs, and subsequent telephone assessments of stage of change at year-three were performed. Independent t-tests revealed individuals who were initially sedentary, and subsequently became active, had higher perceptions of control at baseline than those that remained sedentary. Also, participants that were originally active who maintained their activity, had higher positive attitudes, higher perceptions of control, and stronger intentions at baseline than those who relapsed and became inactive. These results suggest the appropriateness of the TPB constructs for understanding stage of change in older adults.

Courneya et al. (1997) evaluated the relationships among self-report TPB constructs, stage of change, and exercise behavior among 131 older individuals over a one-year period. Path analysis revealed that the TPB constructs were significant predictors of exercise stage, intention mediated the effects of the TPB constructs on stage of change, and exercise behavior was best predicted by intention rather than stage membership. The authors suggest support for the long-term predictive validity of TPB for exercise behaviors. Further, the question of the necessity of the combination of intention and stage in a single predictive model was put forth.

Calfas et al. (1997) evaluated an exercise stage of behavior change intervention for 212 healthy sedentary adults. The intervention consisted of a brief physician counselling session, and at a two-week telephone-delivered follow-up. Hypothesized mediators were process of change, self-efficacy, and social support for exercise. Counselling significantly increased physical activity via self report and objective measures as compared to a control group. One-way ANOVAs showed the intervention had a significant effect on behavioral and cognitive processes of change when comparing the intervention to the control group.

Through multiple regression analysis, no baseline psycho-social variables were significant predictors of stage of change at follow-up, but changes in both behavioral process of change and self-efficacy were found to be the significant predictors regardless of condition and other variables.

Clarke and Eves (1997) examined three TTM constructs (i.e., stage of change, decisional balance and self-efficacy), and a perceived barrier construct in regard to exercise behavior. The sample included 393 United Kingdom middle-aged sedentary adults who were referred to their general practitioner for a three-month prescription for exercise. Newman-Keuls follow-up analysis revealed the pros of exercise significantly increased across stages of change, while the cons decreased. However, the pros did not clearly differentiate adjacent stages of change. ANOVA revealed that self-efficacy was not significantly associated with stage of change, however, MANOVA showed specific barriers were associated with certain stages of change.

Hellman (1997) evaluated 349 older adults (65 years of age and above) with a recent cardiac diagnosis through a computer-assisted telephone interview. Variables studied included stage of change, processes of change, exercise variables (i.e., intensity and frequency), perceived health status, exercise benefits and barriers, prior exercise, self-efficacy, and intrapersonal support. Through direct entry discriminant analysis, self-efficacy, perceived benefits, intrapersonal support, and perceived barriers were found to be significant predictors of exercise adherence. Together they predicted 50% of the variance in stage of change. The theoretical ordering of the stages, from the lowest level of exercise in the precontemplation stage to the highest in the maintenance stage, was supported by the statistical ordering of the group means for each respective stage of change.

Herrick et al. (1997) assessed 393 government employees on decisional balance and exercise self-efficacy measures. Significant differences were found for both decisional balance and self-efficacy indicators across the stages of change. Additionally, self-efficacy showed a positive linear relationship with advancing stage of change, while pros outnumbered cons in precontemplation, contemplation, and the opposite was found in action and maintenance stages.

Potvin et al. (1997) studied 4768 metropolitan, suburban, and rural residents taking part in a baseline survey of the Quebec Heart Health Demonstration Program (56% female). Response rates were 90% for rural, 77% for suburban and 70% for metropolitan residents. Results of a polychotomous ordinal logistic regression model showed that prevalence rates differed significantly between communities, and that rural communities had the highest rates of readiness for physical activity in comparison to suburban and inner-city communities. Suburbanites most likely were in the preparation stage, metropolitan residents were mostly in contemplation or precontemplation, while rural residents were twice as likely to be in active stages of change. The authors suggest structural components such as type of community, as well as individual difference variables, are related to stage of change.

Reed et al. (1997) compared three different samples ($\underline{N}_1$ = 936 medical, manufacturing and retail employees; $\underline{N}_2$ = 19,212 HMO members; $\underline{N}_3$ = 327 adult volunteers) in regard to the effectiveness of differing exercise staging algorithms. It was suggested that an appropriate algorithm includes a clearly defined stage of change, and a complete definition of exercise that includes the dimensions of frequency, intensity and duration. Additionally, both five-choice and true-false formats produce comparable results. The authors concluded that if algorithms are outlined by these factors, then researchers can have increased confidence that they are correctly staging subjects.

Nguyen et al. (1997) used a combined TPB and exercise stage of change model to view the exercise determinants in a sample of 2,269 men between the ages of 30 and 60 years. A self-administered postal questionnaire was used to assess theoretical constructs and behavior. Logistic regression indicated that attitude, subjective norm and perceived behavioral control were differentially associated with stage of change. Perceived behavioral control differentiated all stages. Attitude was related to stages in which individuals have intention of exercising. In contrast, subjective norm was associated with stages in which individuals have no intention of exercising.

Mullan and Markland (1997) evaluated the relationship between self-determinism in the regulation of exercise behavior and stage of change for exercise in 314 individuals. Discriminant function analysis revealed latter stages of change were associated with greater self-determinism than those in earlier stages of change. ANOVA indicated that self-determinism increased from lower to upper stages. The authors suggest an important role exists for motivation in the understanding of exercise change processes.

Cardinal et al. (1998) applied the TTM to 669 preadolescents between the ages of 5 and 11 years (age M = 8.2) to determine if the stage of change construct was applicable to preadolescent exercise behavior change. Development of a new instrument for measuring stage of change for this population was undertaken. Eight measures of physical fitness, as outlined by the Prudential Fitnessgram national fitness test battery (Cooper Institute for Aerobic Research, 1992) were assessed. Demographic, as well as two additional measures that included exercise knowledge and exercise beliefs were assessed using instruments developed for preadolescents by the Centre for Disease Control and Prevention (1997). A one-way MANCOVA (covariates were age and gender) revealed significant between-stage differences on the dependant variables. Chi-squared analysis revealed gender, age, and grade level were significantly related to stage of change. After controlling for these differences, Tukey post hoc contrasts revealed only exercise beliefs differed significantly across stage of change. The authors noted potential limitations of the study including: (a) the temporal sequencing between stage of change and other measured variables cannot be determined, (b) only the stage of change variable of the TTM was studied, (c) results only allow for speculation regarding the application to intervention, and (d) the ethnic and racial diversity of the sample was limited.

Nigg & Courneya (1998) assessed stage of change, process of change use, self-efficacy, and decisional balance constructs in 819 high school students (grades 9 through 12). The cross-sectional study found all the measured constructs were significant discriminators of at least one of the stages of change. Additionally, concurrent validity was shown for the stage of change measure and the three component intensity measures, as well as the overall index provided by the GLTEQ. These findings were offered as support for the applicability of the model in an adolescent population.

Mummery and Spence (1998) collected surveillance data on the activity levels of a sample from the Alberta general population. Participants included individuals aged 18 years and older who could be contacted for a random telephone interview. Total sample size was 1,240 individuals in the 1995 sample, and 1,206 in the 1997 sample. The study's purpose was to describe the activity patterns of Albertans through the stage of change variable. Physical activity was operationalized as activity done in one's leisure time, three or more times per week, for 20 or 30 min each time. Stage classification was into one of the following five stages: precontemplation, contemplation, action, maintenance, or relapse. Preparation was not included because of the difficulty in assessing the range of activities that can be considered preparatory through a telephone interview. Further relapse was broken into relapse-precontemplation or relapse-contemplation.

In Alberta, 51.8% of residents reported being regularly active to the predefined level in 1995 and 54.9% in 1997. In each sub-sample, the majority of individuals in relapse were contemplating the re-initiation of regular physical activity. The authors suggest that the knowledge regarding the behavioral status of select population segments is a key step in the development of effective programs for promoting physical activity. Further, they suggest their findings can be utilized to segment the population for the purposes of social-marketing physical activity.

Bock et al. (1998) evaluated the relationship between stage of change for exercise, dietary, and smoking behaviors. One-hundred and ninety four sedentary men and woman were classified into either the precontemplation, contemplation, or preparation stage of change. Significant differences were found for self-efficacy, decisional balance, time spent exercising per week (seven-day PAR), and both experiential and behavioral process of change use across stages. Self-efficacy, decisional balance, and process of change use all increased with higher stage of change membership.

Readiness to adopt moderate-intensity physical activity was significantly and differentially associated with readiness to reduce dietary fat and healthy eating behaviors, but not with smoking status. Individuals at higher stages of physical activity also were in higher stages for reducing dietary fat, and subsequently reported consuming more fruit and vegetables per day than those in lower stages for physical activity. The authors suggest that the process of initial health behavior change may serve a gatekeeper function, increasing the likelihood of further, or simultaneous change in other health behaviors.

Marcus et al. (1998) studied a subsample of the Working Healthy Research Trial which included individuals from 11 different worksites. Individuals were randomized to either a motivationally-tailored, or a standard intervention. The interventions consisted of printed self-help exercise promotion materials either: (a) matched to the individual's stage of change (motivationally-tailored), or (b) standard materials which consisted of manuals developed by the American Heart Association. These manuals were selected to represent the type of self-help materials that are currently available for the public. Interventions were delivered at baseline and one month, and assessments of stage of change and exercise behavior were collected at baseline and three months.

Among intervention completers ($\underline{n}_1$ = 903), those receiving the motivationally-tailored interventions were significantly more likely to show increases (37% vs. 27%), and less likely to show either no change (52% vs. 58%), or a regression (11% vs. 15%) in stage of change as compared to the standard intervention. This study was the first prospective randomized control-trial demonstrating the effectiveness of a brief motivationally-tailored intervention. Interestingly, the authors suggest that interventions matched to an individual's stage of change should outperform currently available approaches for at least 66% of the population. The authors raise a number of concerns with this study and the body of literature which precedes it. These include the prior near-exclusive use of subjective measures of measuring activity, the need for studying more diverse samples, the problems of the selective use of reactively recruited samples, and the need for more longitudinal studies.

Jue and Cunningham (1998) studied stages of exercise behavior change at two time periods (i.e., 4 to 6 months, and 22 to 26 months post coronary artery bypass graft surgery) in 253 patients from two separate outpatient cardiac rehabilitation programs. Interestingly, 67% of elderly subjects had reported exercising regularly for more than six months. Furthermore, at two years after surgery 69% reported being regularly active. These results differ from those commonly found in most other populations studied (e.g., middle-aged working individuals) that indicate that more than 50% of these individuals dropout of exercise programs within six months of their initiation. The authors suggest that the severity of the disease may have acted as a psychological cue to the initiation of exercise, and furthermore also as a cue its continuation. Also, they note that older individuals as a group were more likely to adhere to their exercise prescriptions. Lastly, the eventual home-based focus of the exercise program may be related to lower dropout rates than those of structured exercise programs in a clinical setting.

Precontemplators were found to be low users of change processes, but counter to the hypothesis so were preparers. While patients in the action stage were among the highest users of the processes of change, contemplators used them at the same level. There was a slight decline in the use of the processes by maintainers. Preparers being low users, and contemplators being high users of the processes, is a unique finding to this study.

Cole et al. (1998) assessed the short-term effects of an exercise intervention by examining the stages people go through as they attempt changes in physical activity. Stage of change was assessed before and after the 50 day intervention in all 1192 participants. These researchers added a sixth stage to the traditionally used five stage measure which they termed late preparation. This was defined as vigorous exercise less than three times per week or moderate physical activity less than five days per week. This was done because similar research indicates that a substantial number of individuals who participate in interventions to promote regular physical exercise report this level of exercise.

Analysis of the findings revealed that 6.5% regressed one or more stages, 30.3% did not regress or progress, 27.7% remained in the maintenance stage, and 35.4% progressed one or more stages. The most common change was from preparation to late preparation. Findings reinforce that the stage of change concept can serve as an indicator of the change process which in turn can be used to indicate the short-term effectiveness of interventions.

Appendix E

Transtheoretical Model: Empirical Review Table

Authors	Sample	Design	Assessment / Measures	Results
Armstrong et al. (1993)	401 adults	Prospective	- 2 year follow-up mail survey - Focused on vigorous exercise of Precontemplators (Prec) & Contemplators (Cont) - Assessed: Stage of exercise change (SOC) (pre and post-test) Self-efficacy (SE)(pre-test) Vigorous exercise (EX) Demographics	- Contemplators (Cont) higher base SE than Precontemplators (Prec) - Cont more likely to report vigorous EX at 6 months post-baseline - Stages and SE equal magnitude predictors of future EX
Barke & Nicholas (1990)	59 older adults 59 - 80 yrs/age	Descriptive	- Assessed: SOC - Compared across active/inactive groups	- Older adults in Action (ACT), Maintenance (Maint), and Cont more than in Prec (as would be predicted by stereotype) - SOC distinguishes older adult groups who vary in activity levels - Validation of SOC construct among elderly individuals
Bock et al. (1998)	194 sedentary adults	Cross-sectional	- Self-report questionnaires - Assessed: for exercise, dietary behavior, and smoking status SOC (Prec, Cont, Prep) Decision Balance (DB) Processes of Change (POC) SE	- SE, DB and POC use all increased with increasing stage - Motivational readiness to adopt moderate-intensity physical activity was significantly and differentially associated with readiness to reduce dietary fat and healthy eating behaviors, but not with smoking status - Results suggest that the process of making a behavior change may be mediated by a common set of variables that are not specific to the particular targeted behavior, but rather reflect underlying mechanisms for the process of behavior change (initial change serving a "gatekeeping function" for further health change)
Booth et al. (1993)	4044 Australian adults	Cross-sectional	- Face-to-face interview - Assessed: SOC Benefits of EX Sociodemographics	- Systematic relationship b/w stage and activity level - Lower stages, less likely to endorse health benefits of EX - EX frequency and intention (INT) decreased with age - Interventions should focus on those who do not intend to EX, older adults, and the less educated - Higher education was related to a lesser chance of being in lower stages

Buxton et al. (1994)	102 M & 80 F University employees	Cross-sectional	- Assessed: SOC Perceived physical condition SE VO^2 max EX intensity	- Both concurrent validity and measurement reliability found for this sample - Discriminating variables: Males - perceived physical conditioning & SE Females - perceived physical conditioning, VO^2 max & very hard activity participation
Calfas et al. (1997)	212 Healthy sedentary adults	Intervention	- Telephone delivered - Baseline / intervention / follow-up - Assessed: EX SE SE for making time for EX SE for ability to change Social support for EX SOC Processes of change (POC) Demographics - Test of construct validity	- Intervention subjects significantly increased PA (via self-report and objective measures) - Supports the construct validity of the SOC model - Postintervention measures found an increased use of behavioural and cognitive POC. However, SE (study duration?) and social support (individual nature of task?) not effected - Strongest mediators of EX (baseline), via hierarchical multiple regression, are behavioral POC and SE (recommended targets of intervention) - No one variable appeared as a primary mediator of change in exercise behavior.
Cardinal (1997a)	47 female clerical workers	Prospective	- Inter-office mail-delivered - Baseline, 1 month, and 7 month assessments - Assessed: EX SOC Demographics	- No significant differences were found for stage between baseline and 7 months. - In a step-wise regression, education, BMI, and initial stage of exercise were able to explain a significant proportion of the variance in stage of exercise improvement at 1-month. At 7-months the only significant predictor of stage of exercise improvement was baseline stage of exercise.
Cardinal (1997b)	235 M & F Adults	Cross-sectional	- Assessed: SOC Body mass index (BMI) Cardiorespiratory fitness (VO_2 max) EX behavior (2 measures) Relapse Barriers SE Demographics	- SOC membership differed significantly and meaningfully on all outcome measures while concurrently controlling for possible confounding variables - General linear pattern of improvement across SOC - Older, married and African-Americans were more likely to be at an earlier SOC

Cardinal (1995)	8 F & 6 M adults	Descriptive	- Participants evaluated 1 of 2 sets of EX promotional materials -Lifestyle EX Pack (LEP) SOC matched intervention techniques (exercise as a 'lifestyle') - Structured EX pack (SEP) (SOC matched) included promotion via guidelines of American College of Sports Medicine (ACSM) (promotion of structured EX) - Evaluated using a modified version of Educational Materials Review Form	- No significant differences in rankings of the package's ability to be effective in increasing EX
Cardinal & Sachs (1995)	113 Female university clerical workers	Intervention	- Baseline SOC assessed and participants stratified by stage - Received 1 of 3 mail-delivered intervention packs; the first 2 (See Cardinal 1995a), third was a control condition	- LEP group least likely to dropout - LEP most likely to advance stage at 1 and 7 months post-baseline - All effective interventions, interestingly control better than SEP
Cardinal et al. (1998)	669 preadolescents (mean age 8.2 years)	Cross-sectional	Assessed: SOC Demographics Objective fitness battery EX knowledge EX beliefs	- SOC significantly related to gender, age and grade level - After age and gender are controlled for, the only difference between SOC was exercise beliefs
Clarke & Eves (1997)	393 British middle-aged, sedentary adults	Cross-sectional	- Assessed: SOC DB SE EX barriers Demographics	- Pros increased and cons decreased across stages. However, the pros scale did not clearly differentiate between SOC. - SE scores were not significantly associated with SOC - Specific barriers associated with certain SOC
Cole et al., 1998	1192 federal agency employees	Intervention (50 days)	- Assessed: Modified SOC	- Note: Intervention protocol not provided. - The stages of change concept can serve as an indicator of the change process which in turn can be used as evidence of the short term effectiveness of intervention
Courneya, Estabrooks, et al. (1997)	147 older adults 60+ yr/age	Prospective	- Telephone delivered 3 year follow-up - Theory of Planned Behavior (TPB) variables assessed via mail survey - SOC assessed as Resisters, Maintainers, Adopters or Relapsers	- Supports the TPB in the prediction of progression and regression through SOC - Perceived Behavioral Control (PBC) was the only significant predictor for the progression from inactive to active SOC - Attitude (ATT), PBC & Intention (INT) all significant predictors of regression from active to inactive SOC

Courneya et al. (1998)	131 older adults 60+ yr/age	Prospective	- Baseline mail survey - 3 year follow-up telephone delivered - Assessment (baseline/follow-up): SOC TPB constructs EX	- PBC, ATT & subjective norm (SN) equally important predictors for EX intention at baseline - EX best predicted by baseline INT, rather than stage - TPB constructs (except SN) valid predictors of SOC 3 years follow-up - Questions the utility of both INT and SOC as predictors of EX over time (INT and behavior as possibly separate constructs) - TPB constructs compare closely to SE and DB measures of the Transtheoretical Model (TTM)(PBC actually outperformed. Significance yet to be determined. Hypothesized the addition of INT to TTM)
Courneya (1995a)	288 older adults 60+ yr/age	Cross-sectional	- Initial questionnaire mail-delivered - Assessed (Pilot study): SOC EX history Demographics - Included open-ended questions regarding behavioral and control beliefs - Assessed (2 weeks post): TPB constructs SOC	- Significant linear relationship between each TPB constructs and SOC (except SN) - Most important discriminators b/w SOC were INT, ATT & PBC - Every stage could be distinguished from one another via TPB constructs except ACT from Maint (small sample size?) - Demographics did not provide unique information about SOC membership
Courneya (1995b)	270 60+ yr/age	Cross-sectional	- Assessed: SOC Perceived severity (PS) Visibility Rate of onset Time of onset EX	- Supports integration of SOC with PS construct - PS separated Prec from higher stages - PS may function to motivate people to seriously consider becoming active - Fear appeals effective maximally for Prec and Prep (?) - PS separated Prep from ACT and Maint stages (PS similar ro POC of dramatic relief - Visibility of disease was the most important dimension of PS
Cowan et al. (1997)	182 adult primary care patients	Cross-sectional	- Assessed: SOC SE BMI	- No significant association between BMI and exercise stage of change, but it did approach significance. - No significant differences between obese and non-obese on self-efficacy. - Self-efficacy scores did differ by stage of change with action/maintenance having significantly higher self-efficacy than those in precontemplation.
Godin et al (1995)	347 adults	Prospective	- Face-to-face baseline questionnaire assessing: SOC (habit & intention) & Global ATT, Global SN, PBC, Belief-based ATT, Belief-based SN & perceived barrier to EX - EX behavior (self-report) assessed at follow-up to ensure predictive validity of SOC	- Follow-up measure of EX behavior supported predictive validity of all SOC. Thus, it is appropriate to operationalize stages in terms of past behavior and intention - SOC correspond to specific beliefs and attitudes, PBC important to transitions b/w stages

Gorely & Gordon (1995)	583 50-65 yr/old Australian adults	Cross-sectional	- Mailed or take-home questionnairedelivery - Assessed: SOC POC SE DB	- Supports the structure of the TTM: POC, SE & DB. All important in differentiating SOC - Prec used the POC less than all other stages - Only 5 of 10 POC made a significant contribution to predicting SOC - SE increased steadily from Prec to Maint - DB: Prec greater emphasis on cons Maint greater emphasis on pros
Hellman (1997)	349 65+ yr/old adults with cardiac disorders	Cross-sectional	- Telephone interview - Assessment: SOC POC EX (intensity/freq.) Perceived health status EX benefits/barriers EX behavior prior to cardiac event SE for EX Interpersonal support	- Perceived SE, perceived barriers, interpersonal support, perceived strength of physician's recommendations and perceived benefits significant predictors of EX adherence - All variables and their hypothesized relations to SOC supported - Experiential processes and smoking status contributed to the differentiation b/w the Prec and Cont
Herrick et al (1997)	393 government employees	Cross-sectional	- Assessed: SOC DB SE Demographic variables	- Significant differences found for both DB and SE scores across SOC - Pros higher during ACT and Maint than Prec - Cons lower during ACT than Prec - SE differentiated b/w SOC. It showed a positive linear relationship with advanced SOC.
Jue & Cunningham (1998)	253 postsurgical coronary bypass graft surgery patients	Prospective	- Mail delivered - Assessments at 4 to 6, and 22 to 26 months postsurgery - Assessed: SOC POC	- 67% had become long term exercisers. - Interventions should focus on the smaller percentage of patients in earlier stages of exercise change. - Relapse prevention techniques are also needed to maintain these exercise behaviors - Prec and Prep lowest users of POC, Cont and ACT the highest
Lee (1993)	286 Australian F 50 - 64 yrs/age	Cross-sectional	- Telephone delivered - Questions defined by pilot study - Assessed: Demographics EX knowledge, ATT, opinions EX preferences & availability EX recall SOC	- SOC related to ATT, EX knowledge & demographic variables - Prec individuals were generally older, had less EX knowledge, had lower family support, expected fewer psychological benefits, and rated EX as less important than avoiding smoking for one's health - Older individuals typically at lower stages - Cont differed from other stages on perceived barriers to EX - Perceptions of family support differentiated b/w Prec and ACT

Marcus, Banspach, et al. (1992)	610 adults 18 - 82 yr/old (77% F)	Intervention	- Community-wide recruitment of non- and occasional-exercisers - Registration included SOC measure - Received stage-matched intervention package including: written materials, community activity options, & weekly organized EX activity nights - Follow-up (N=236) 3 weeks post-intervention	- Most subjects increased stage across intervention period - 30% of Cont at baseline advanced to ACT - 60% of Prep at baseline advanced to ACT
Marcus, Eaton, et al. (1994)	698 worksite employees	Prospective & cross-sectional (3-step model building)	- Assessed: SOC EX SE DB EX - Follow-up assessed EX SE EX	- Cross-sectional findings: Level of EX can be predicted by SOC, pros/cons of EX and EX SE - Longitudinal findings: SE is strongly related to INT, which is a strong predictor of EX 6 months later High number of pros, low cons & high SE are indirectly related to EX through SOC
Marcus & Owen (1992)	(a) 1093 Australian worksite employees (b) 801 Australian worksite employees	Cross-sectional	- Assessed: SOC SE DB	- SOC membership proportions nearly equal in the 2 samples. SE was significantly related to SOC in both. DB related to SOC in both - Large pro/con difference at Prec. Eroded by Cont
Marcus, Pinto, et al. (1994)	431 worksite F	Cross-sectional	Assessed: SOC SE DB EX Demographics	- SE and DB related to SOC membership - Prec lowest and Maint highest on SE, pro and DB indices. Cons showed the reverse pattern - Demographics generally not related to SOC (except for women with children at home, and those married)
Marcus, Rakowski, et al. (1992)	778 worksite employees	Cross-sectional	- Assessed: SOC DB (assessment measure construction)	- DB related to SOC membership
Marcus, Rossi, et al. (1992)	1172 overweight, predominantly F worksite employees	Cross-sectional	- Half of sample used in POC questionnaire development. The second half was a cross-validation - Assessed: POC questionnaire (self-report) SOC Demographics	- All 10 POC used in this sample - Hierarchical organization of constructs (experimental / behavioral) supported - SOC related to POC usage - Prep used behavioral processes more than Cont, but experiential POC use did not differ - ACT used experiential and behavioral POC more than Prep - Maint decreased in the use of experiential POC only, as compared to ACT

Marcus, Selby, et al. (1992)	1. 1063 Government workers 2. 429 Medical centre employees 3. 20 Medical centre employees	1. Instrument development (Cross-sectional) 2. Instrument refinement (Cross-sectional) 3. Instrument reliability (Prospective)	- Study 1 Assessment: SOC (SOC measure development) SE Demographics - Study 2 Assessment: Same as study 1 (included small structural refinements) - Study 3 Assessment: Same as study 1 but included a 2 week follow-up	- Study 1 - SE related to SOC: Prec had the lowest, Maint had the highest SE, however, clear differentiation b/w SOC was not found - No demographic relation to SOC or SE - Study 2 - Same as study 1 - Study 3 - Strong test-retest reliability for SE and SOC measures
Marcus & Simkin (1993)	235 worksite employees	Cross-sectional	- Assessed: SOC EX (7-day recall) - Test of concurrent validity	- Significant differences in EX among the grouped SOC constructs (Prec & Cont, Prep, ACT & MAIN) - Prep had more moderate and vigorous activity than Prec/Cont - ACT/Maint differed from Prep in terms of vigorous EX - Thus, SOC differentiated by self-report EX - Concurrent validity with well-accepted PA questionnaire
Marcus et al. (1996)	314 worksite employees	Prospective	Assessed at baseline and follow-up: SOC POC Classification into 1. Stable/sedentary 2. Stable/Active 3. Adopters 4. Relapsers	- Use of POC remained stable over time for those who didn't change behavior - POC use increased for adopters, decreased for relapsers - Most adopters were in Cont at baseline (supports INT) - Most relapsers slipped into Cont (behavior supported in relapse) - Among adopters, only social liberation did not increase significantly - Among relapsers all behavioral POC, but only one cognitive POC (dramatic relief) decreased significantly - Ongoing behavioral skills training is critical for long term EX behaviors - Cognitive foundation does not falter during relapse, but behavioral skills do - Dramatic relief was the only cognitive process that decreased in relapse, this may suggest a strong belief in the benefits of EX may lessen when one is not engaged in EX
Marcus et al. (1998)	1559 M and F from 11 different worksites	Intervention (3 months)	Interventions delivered at baseline and one month Assessed: (baseline and three months) SOC	- Motivationally (stage of change) tailored approach resulted in significantly greater progression, and less stability and regression in motivation to adopt exercise, than the standard intervention - First prospective randomized controlled trial to demonstrate the superior efficacy of brief motivationally tailored interventions compared to state-of-the-art standard self-help manuals

Mullan & Markland (1997)	314 adult M and F worksite employees	Cross-sectional	Inter-office mail-delivered Assessed: Self-Determinism SOC	- Those in the latter stages of change were more self-determined than those in earlier stages of change - Self-determinism increased from lower to upper stages of change
Murphy (1993)	Group (a) 303 'Working' 18 - 64 yrs/age Group (b) 331 'Older' 65+ yr/age	Cross-sectional / Longitudinal	- Mail delivered - Assessed Phase I:POC SOC Phase II: EX behavior (EX history questionnaire) EX INT (EX intention questionnaire) Step test (physiological conditioning) One month follow-up N=20 Prec/Comp N=20 ACT/Maint	- Phase I: (POC in acquisition and maintenance of EX) SOC construct supported 6 POC used by 'working'; 4 POC used by 'older' 4 POC shared by both: Counter-conditioning, Self reevaluation, helping relationships and Stimulus Control 'Working' also used consciousness raising and dramatic relief 'Older also used social liberation process 'Older' used most processes less than 'Working', except Prep Similar method of progression through stages - Phase II: (Test of external validity) All 4 alternative approaches to classification of EX (behavior and/or INT assessment) showed high congruence with SOC
Mummery & Spence (1998)	1240 Albertans (1995 sample); 1206 Albertans (1997 sample)	Descriptive	Telephone interview Assessed: SOC	- 52% of Albertans are regularly active in 1995. 55% in 1997 - Relapse was assessed and broken into relapse-precontemplation and relapse-contemplation
Nguyen, Potvin, & Otis (1997)	2269 men 30 - 60 years of age	Cross-sectional	Mailed questionnaires Assessed: SN PBC ATT Intention Behavior SOC	- PBC had strong associations with all SOC - ATT, SN, perceptions of health status had strong associations with some, and weak associations with other SOC - The combination of the TPB and SOC can elicit more detailed results than the use of either alone
Nigg & Courneya (1998)	819 high school students (grade 9 - 12)	Cross-sectional	Assessed: SOC POC SE DB EX	- All constructs differed significantly across SOC - POC, SE and DB all contributed significantly to explaining variance between SOC - Support was found for the applicability of the TM to adolescent populations
Perna et al. (1997)	57 stage I and II breast cancer patients at 3 months post-surgery	Cross-sectional	- Assessed: SOC Aerobic EX frequency Perceived barriers to EX Negative effect Medical/demographic variables	- SOC relationship with other variables were not reported. Simply utilized as a descriptor - breakdown not reported

Pinto & Marcus (1995)	217 university students	Cross-sectional	Assessed: Modified SOC Demographic Year of school Place of residence	- Approximately half of the students were inactive or exercising irregularly - Gender and year of school were found to be unrelated to stage of change
Potvin et al (1997)	4768 Metro, suburban & rural residents	Cross-sectional	- Assessed: INT to modify health behaviors SOC Disease status Demographics	- Suburbanites mostly in Prep - Metropolitans mostly in Cont and Prec - Rural twice as likely to be active - Higher educated persons closer to ACT - Older closer to Prec - Higher presence of disease the closer one is staged to Prec
Prochaska et al (1994)	717 worksite employees	Cross-sectional	- Assessed: SOC DB	- Pros/cons represent decisional categories for making behavior change across categories - Cons outnumber pros at Prec stage. The opposite was found in the action stage. Crossover occurred at the Prep stage
Reed et al (1997)	(a) 936 medical, retail & manufacturing employees (b) 19212 New England HMO members (c) 327 adult New England residents	Descriptive	- Comparing different algorithms for staging EX behavior	- Standards for a good algorithm including clearly describing the SOC and using a complete definition of exercise that includes frequency, duration and intensity. - Both 5-choice and true/false response format produce comparable results. If algorithms are written using these outlined factors, then researchers could have more confidence that they are correctly staging subjects.
Sonstroem (1988)	220 M 30+ yr/age	Prospective (4 years)	- Assessed: SOC EX history (Prec, Cont, recruits, adherers)	- Dropouts from EX represent several subsets within individual SOC, some who attend to, and some who do return to EX
Wyse et al. (1995)	244 young British adults (16-21 yrs/age)	Cross-sectional	- Assessed: SOC EX BMI SE Physical self-perception Global self-esteem	- Large differences b/w SOC for high intensity exercise - Moderate and high intensity EX showed predicted relationship to SOC - No significant differences for BMI b/w SOC - No difference in self esteem scores b/w stages - Physical self-perception and global self esteem measures show the adoption and maintenance of regular EX appears to be associated with feelings about self and especially the physical self - Female perceived body attractiveness did not change with stage, however the males did - SOC was most related to the intensity of EX involved in (supports concurrent validity of SOC)

Appendix F

Physician Contact Letter

Dear Dr.

My name is Dr. Kerry Courneya and I am an Associate Professor in the Department of Oncology at the University of Alberta. I am also a member of the Scientific Staff of the Cross Cancer Institute (Edmonton). As part of my responsibilities, I conduct research in the area of exercise and cancer. I am currently conducting a survey study which requires the voluntary participation of breast cancer survivors. My co-investigator on the project is Mr. Todd Bobick, who is one of my current graduate students. This study has been reviewed by the Alberta Cancer Board's Research Ethics Committee, and has met the rigorous requirements for ethical approval. You have been contacted because you are the family/referring physician or surgeon of an individual, or individuals, whose name(s) have been identified through the Alberta Cancer Registry as meeting our inclusion criteria. As part of the current ethical approval process, we must obtain "active consent" from the physicians of these individuals before our study can commence.

We are only asking your permission to mail the identified patient(s) an information and questionnaire package. She will then have the option of whether to volunteer through the completion of the sent questionnaire, or not by disregarding the information. If there are any compelling reasons for not mailing this information to this/these individual(s), please contact Todd - Phone: (403) 492 - 2829, Fax: (403) 492-2364, or E-mail: tbobick@gpu.srv.ualberta.ca.

I hope to hear from you, or from one of your representatives, in the near future. If I have not received correspondence from you within the next week, I will then be in contact with you by telephone at that time. Thank you in advance for your cooperation.

Sincerely,

Kerry Courneya, Ph.D.
Associate Professor, Department of Oncology
Scientific Staff, Cross Cancer Institute
University of Alberta

Todd Bobick, B.Sc.
Graduate Student
Faculty of Physical Education
University of Alberta
Tel: (403) 492 - 2829

Appendix G

Introductory Letter

Dear Ms.

My name is Dr. Kerry Coumeya and I am an associate professor in the Department of Oncology at the University of Alberta. I am also a member of the Scientific Staff of the Cross Cancer Institute (Edmonton). As part of my responsibilities, I conduct research in the area of exercise and cancer. I have contacted you because you are eligible to participate in one of my current projects on exercise and breast cancer survivors and I would like to invite you to do so. My co-investigator on the project is Mr. Todd Bobick who is one of my current graduate students. The study has been reviewed by the Alberta Cancer Board's Research Ethics Committee and has met the rigorous requirements for ethical approval. Please be assured that your name and any personal information has not and will not be released to anyone other than myself and Mr. Bobick and we will hold this information in strict confidence.

In our previous research we have found that exercise may be beneficial to the physical fitness and quality of life of breast cancer survivors. However, we have also found that many breast cancer survivors have difficulty maintaining a regular exercise program once their treatments are completed. In this study, we are trying to look at the exercise patterns of breast cancer survivors and some of the factors that influence these patterns. This information will be very helpful to us in designing specific motivational/informational materials for breast cancer survivors interested in exercise. We hope that you will help us out by participating in the study.

What do I have to do to participate?
It is actually quite simple. All we ask is that you complete the enclosed questionnaire and return it to us at your earliest convenience. That's it! The entire questionnaire should take less than 45 minutes of your time. We have provided a self-addressed, stamped envelope for your convenience and instructions are provided on the front of the questionnaire.

But I don't exercise and so I won't be of any help!
Yes you will! It is only by understanding the issues of **both** exercisers and non-exercisers that we can hope to gain a fuller understanding of all that is involved in woman's decision of whether or not to exercise following breast cancer treatment.

Do I have to participate?
Absolutely not! Your participation in completely voluntary. If you choose not to participate please disregard this, or any future information you may receive about our study. However, it is only through voluntary participation in research projects that we increase our knowledge about issues that are important to breast cancer survivors. We hope you can find the time to help us out. If you have any questions about the study or about completing the questionnaire, please feel free to call us collect at the numbers provided below.

Sincerely,

Kerry Courneya, Ph.D.
Associate Professor, Department of Oncology
Scientific Staff, Cross Cancer Institute
University of Alberta

Todd Bobick, B.Sc.
Graduate Student
Faculty of Physical Education
University of Alberta
Tel: (403) 492 - 2829

Appendix H

Consent Form

Physical Exercise: Beliefs, Attitudes and Behavior in Breast Cancer Survivors

Investigators: Kerry Courneya, Ph.D.& Todd Bobick, B.Sc.

CONSENT FORM

This consent form, a copy which has been given to you, is only part of the process of informed consent. It should give you the basic idea of what the research project is about and what your participation will involve. Please take time to read this carefully and understand the information.

Background Information

Kerry Courneya, PhD, associate professor in the Department of Oncology and member of the Scientific Staff at the Cross Cancer Institute (Edmonton), along with Todd Bobick of the University of Alberta, are conducting a study of factors that affect exercise in breast cancer survivors. This will be done through mail-delivered surveys delivered to breast cancer survivors identified through the Alberta Cancer Registry.

Purpose

We will be asking you questions addressing your feelings about, and your participation in, physical exercise. This provides us a more complete understanding of exercise behavior in breast cancer survivors. Further, this assists us in creating specific motivational and informational materials which are utilized by those who chose to exercise after their cancer experience, but are having trouble getting started, or in keeping going.

Description of the Study

Your participation in the study involves the completion of the enclosed questionnaire. Specifically, the questionnaire will cover information concerning personal characteristics, exercise beliefs and attitudes, as well as current and past exercise habits. The questionnaire, as attached, should take about 45 minutes to complete. If any question asks for information that you are not comfortable in providing, you are not required to do so - just leave it blank and move on to the next question.

Risk and Benefits of Study Participation

Some possible risk is involved if you choose to participate in this study. We will be asking you to recall your cancer experience, which for some may be traumatic. If this is problematic for you, you need not participate. If you would like someone to speak to about your cancer experience, you may contact the Department of Psychology at the Cross Cancer Institute (403) 432- 8703, or the Department of Psychosocial Resources at the Tom Baker Cancer Centre (403) 670-1767. Also, it is not expected that there will be any personal benefit to you. However, your participation may help improve patient care in the long term.

Participant's Initials ________ Date: ______________ Page 1 of 2

Confidentiality

If you join the study, members of the research team of the University of Alberta may want to look at your medical records as it relates to this study. This organization will treat such information with total confidentiality. This means no records with your name will be provided to anyone not directly involved in this research. You will not be identified as an individual in any report coming from this study. All material and data obtained from this study will be stored and may be used for future study without obtaining further consent from you. However, any future study utilizing the information obtained in this study will be presented to the Research Ethics Committee of the Alberta Cancer Board.

Understanding of Participants

I am signing this form to show that I have read the consent form and that I have understood to my satisfaction the information regarding my participation in this study. Further, I agree to participate in this study. In no way does this waive my legal rights nor release the investigators, sponsors, or involved institutions from their legal and professional responsibilities. I am free to withdraw from the study without jeopardizing my health care. If I have further questions concerning this research study, I may call the research coordinators at:

Kerry Courneya, PhD, The University of Alberta: (403) 492 - 1031
Todd Bobick, The University of Alberta: (403) 492 - 2829

If I have any questions concerning my rights as a possible participant in this research, I may contact the Patient Advocate (403) 492 - 8585. I will get to keep a copy of this consent for information and for future reference.

(PRINT NAMES CLEARLY)

____________________ Name of Participant	____________________ Signature of Participant
____________________ Name of Witness	____________________ Signature of Witness
____________________ Name of Principal Investigator	____________________ Signature of Principal Investigator

____
Date

Appendix I

Postcard Reminder

Survey Reminder

This is just a reminder that we ask for your support in completing the research package that was recently mailed to you. If you have either already completed, or have chosen not to participate, we thank you for your time and effort. If you are interested in participating and have not yet done so, we would appreciate you completing the survey at your earliest convenience.

Thank You.

Sincerely,

Dr. Kerry Courneya	Todd Bobick
Associate Professor	Graduate Student
University of Alberta	University of Alberta
Tel: (780) 492 - 1031	*Tel*: (780) 492 - 2829

Appendix J

Demographic-Medical Questionnaire

This part of the questionnaire is needed to help understand the characteristics of the people participating in this study and is very important information. All information received is held in strict confidence and its presentation to the public will be group data only. If you do not know the answer to any question, or you do not wish to answer it, simply leave it blank and move to the next question. Please answer the following to the best of your knowledge.

I. Demographic Information

1. Age: ______

2. Marital Status: Never Married _____ Married _____ Common Law _____
Separated _____ Widowed _____ Divorced _____

3. Education: Some High School _____ Completed High School _____
Some University/College _____ Completed University/College _____
Some Graduate School _____ Completed Graduate School _____

4. Annual Family Income: < $20,000 __ $20,000-$39,999 __ $40,000-$59,999 __
$60,000-$79,999 __ $80,000-$99,999 __ >$100,000 __

5. Employment Status: Homemaker ____ Retired ____
Part Time ____ Full Time ____
Temporarily Unemployed ____

6. Height and Weight Information: Weight in pounds ______ or kilograms ________
Height in feet/inches ______ or metres/cent. _______

This part of the questionnaire is needed to help understand the medical characteristics of the people participating in the study. All information is held in strict confidence and its presentation to the public will be in group data only. If you feel uncomfortable answering any of the questions, please feel free to leave them blank. Also, you may not know the answers to some of the medical questions, if you do not just circle DK (Don't Know). Please answer the following to the best of your knowledge.

II. Medical Information

7. Month and year of your breast cancer diagnosis: month ______ / year ______ DK

8. "Stage" of your disease (i.e., I, II, III, or IV): ________________________ DK

9. Type of surgery you had (e.g.,. mastectomy, lumpectomy): ______________ DK

10. Did you receive chemotherapy (please circle)? **Yes** **No**

How long did you receive chemotherapy for (number of months)? ________ DK

11. Did you receive radiotherapy (please circle)? **Yes** **No**

How long did you receive radiotherapy for (number of months)? _________ DK

12. Did you receive hormone therapy (please circle)? **Yes** **No**

If "yes" please choose: a) I am presently still taking hormone therapy _________

b) I have completed my hormone therapy ____________

If (b) how long did you receive hormone therapy (number of months)? _______________ DK

* Anything about your cancer diagnosis or treatment that we missed? Please add it to the back of this questionnaire.

Appendix K

Stages of Change Questionnaire - Prediagnosis

The following questions ask you to recall your exercise pattern at three different time points in your life: (1) before you were diagnosed with cancer, (2) during your treatment for cancer, and (3) since the time your treatment has been completed. Exercise is defined here as any activity performed on a repeated basis over an extended period of time with the intention of improving physical fitness and health. Some examples of exercises include jogging, aerobics, weight training, and strenuous sports. Regular exercise is defined as exercise done at least 3 times per week, for at least 20-30 minutes in duration, and at least moderate to vigorous intensity. Read all statements first, then place an "X" beside the statement that best describes your exercise pattern **before you were diagnosed with cancer.**

Before my diagnosis:

______ I **was not** exercising and I was **not** thinking about starting in the near future.

_______ I **was not** exercising but I **was** thinking about starting in the near future.

_______ I **was not** exercising regularly but I **was** exercising occasionally (i.e., once or twice per week).

_______ I **was** exercising regularly but had only begun to do so within the last **six months**.

_______ I **was** exercising regularly and had been doing so for **longer** than **six months** but **less** than **5 years**.

_______ I **was** exercising regularly and had been doing so for **longer** than **five years**.

Stages of Change Questionnaire - Active Treatment

Please select the one statement that best describes your exercise pattern **during your treatment**. Treatment is defined here as the period after surgery that you were receiving adjuvant chemotherapy and/or radiation therapy. This period will be considered completed when the last day of your chemo and/or radiation treatment occurred. Hormone therapy agents (e.g., Tamoxifen) and other drugs used for long term cancer management will not be considered as treatment for this studies purpose. Read all statements first, then place an "X" beside the statement that best describes your exercise pattern **during treatment.**

During my treatment:

______ I **did not** exercise and I **did not** seriously consider exercising.

_______ I **did not** exercise but I was thinking about trying to start.

_______ I **did not** exercise regularly but I **did** exercise occasionally (i.e., once or twice per week).

_______ I exercised regularly.

Stages of Change Questionnaire - Posttreatment

Please select the one statement that best describes your **current** exercise pattern. Read all statements first, then place an "X" beside the statement that best describes your **current** exercise pattern.

I currently:

______ do **not** exercise and I am **not** thinking about starting in the near future.

_______ do **not** exercise but **I am thinking** about starting in the near future.

_______ do **not** exercise regularly but I do exercise **occasionally** (i.e., once or twice per week).

_______ **do** exercise regularly (if you check this item, please answer the following 2 questions).

1. I started as soon as my treatment was completed. _____ Yes _____ No

2. I have been doing so for longer than six months. _____ Yes _____ No

Appendix L

Processes of Change Questionnaire

These questions are about your thoughts related to exercise. Please read the following, think back over the last month and circle the frequency that each of the following has occurred. Use the following scale:

1 Never	2	3	4	5 Repeatedly

1. I recall information people have personally given me on the benefits of exercise	1	2	3	4	5
2. I think about information from articles and advertisements on how to make regular exercise part of my life	1	2	3	4	5
3. I read articles about exercise in an attempt to learn more about it	1	2	3	4	5
4. I look for information related to exercise	1	2	3	4	5
5. Warnings about health hazards of inactivity move me emotionally	1	2	3	4	5
6. Dramatic portrayals of the evils of inactivity move me emotionally	1	2	3	4	5
7. I react emotionally to warnings about an inactive lifestyle	1	2	3	4	5
8. I feel I would be a better role model for others if I exercised more regularly	1	2	3	4	5
9. I wonder how inactivity affects those who are close to me	1	2	3	4	5
10. I realize that I might be able to influence others to be healthier if I would exercise more	1	2	3	4	5
11. Some of my friends might exercise more if I did	1	2	3	4	5
12. I am considering the idea that regular exercise would make me a healthier, happier person to be around	1	2	3	4	5
13. I think about the type of person I will be if I keep exercising	1	2	3	4	5
14. I get frustrated with myself when I don't exercise	1	2	3	4	5
15. I consider the fact that I would feel more confident if I exercised more regularly	1	2	3	4	5
16. I find society changing in ways that make it easier to exercise	1	2	3	4	5
17. I am aware of more and more people encouraging me to exercise these days	1	2	3	4	5
18. I notice that more businesses are encouraging their employees to exercise by offering fitness courses and time off to work out	1	2	3	4	5

1	2	3	4	5
Never				Repeatedly

19. I am aware that many health clubs now provide free baby-sitting services to their members........................ 1 2 3 4 5
20. Instead of remaining active, I engage in some activity 1 2 3 4 5
21. Rather than viewing exercise as simply another task to get out of the way, I try to use it as my special time to relax and recover from the day's worries..................... 1 2 3 4 5
22. When I feel tired, I make myself exercise anyway because I know I'll feel better afterwards................. 1 2 3 4 5
23. When I feel tense, I find exercise a great way to relieve my worries.. 1 2 3 4 5
24. I have someone on whom I can depend when I am having problems with exercising.............................. 1 2 3 4 5
25. I have an active friend who encourages me to exercise when I don't feel up to it.. 1 2 3 4 5
26. I have someone that points out my reasons for not exercising.. 1 2 3 4 5
27. I have someone that provides feedback about my exercising.. 1 2 3 4 5
28. I reward myself when I exercise 1 2 3 4 5
29. I try to set realistic goals for myself rather than setting myself up for failure by expecting too much.............. 1 2 3 4 5
30. When I exercise, I tell myself that I'm being good to myself by taking good care of my body in this way... 1 2 3 4 5
31. I do something nice for myself for making efforts to exercise more.. 1 2 3 4 5
32. I tell myself I am able to keep exercising if I want to 1 2 3 4 5
33. I tell myself that if I try enough I can keep exercising 1 2 3 4 5
34. I make commitments to exercise 1 2 3 4 5
35. I remind myself that I am the only one who is responsible for my health and well-being, and that I can decide whether or not I will exercise.............. 1 2 3 4 5
36. I put things around my home to remind me of exercising.. 1 2 3 4 5
37. I keep things around my place of work (school) that remind me of exercising... 1 2 3 4 5
38. I remove things that contribute to my inactivity 1 2 3 4 5
39. I avoid spending long periods of time in environments that promote inactivity... 1 2 3 4 5

Appendix M

Self-Efficacy Questionnaire

Please read the following items and circle the number that best describes how confident you are that you can exercise regularly when considering different factors. Use the following scale:

0 1 2 3 4 5 6 7 8 9 10

Not at all confident — Completely confident

I am confident I can exercise regularly:

1. Without injuring myself............... 0 1 2 3 4 5 6 7 8 9 10
2. Without embarrassing myself...... 0 1 2 3 4 5 6 7 8 9 10
3. When I am having pain................ 0 1 2 3 4 5 6 7 8 9 10
4. When I am tired............................ 0 1 2 3 4 5 6 7 8 9 10
5. When I am in a bad mood............. 0 1 2 3 4 5 6 7 8 9 10
6. When I have been inactive for a period................................... 0 1 2 3 4 5 6 7 8 9 10
7. When I feel I don't have time....... 0 1 2 3 4 5 6 7 8 9 10
8. When it is raining or snowing....... 0 1 2 3 4 5 6 7 8 9 10
9. When I am on vacation................. 0 1 2 3 4 5 6 7 8 9 10

Appendix N

Decisional Balance Questionnaire

Please read the following items and indicate how important each statement is in respect to your decision to exercise or not by circling the appropriate number. Use the following scale:

1	2	3	4	5
Not important				Extremely important

1. I would have more energy for my family and friends if I exercised regularly 1 2 3 4 5
2. Regular exercise would help me relieve tension 1 2 3 4 5
3. I would feel more confident if I exercised regularly 1 2 3 4 5
4. I would sleep more soundly if I exercised regularly 1 2 3 4 5
5. I would feel good about myself if I kept my commitment to exercise regularly 1 2 3 4 5
6. I would like my body better if I exercised regularly 1 2 3 4 5
7. It would be easier for me to perform routine physical tasks if I exercised regularly 1 2 3 4 5
8. I would feel less stressed if I exercised regularly 1 2 3 4 5
9. I would feel more comfortable with my body if I exercised regularly 1 2 3 4 5
10. Regular exercise would help me have a more positive outlook on life 1 2 3 4 5
11. Regular exercise would give me a sense of control over my life 1 2 3 4 5
12. Regular exercise would help me prevent disease 1 2 3 4 5
13. I think I would be too tired to do my daily work after exercising 1 2 3 4 5
14. I would find it difficult to find an exercise activity that I enjoy that is not affected by bad weather 1 2 3 4 5
15. I feel uncomfortable when I exercise because I get out of breath and my heart beats very fast 1 2 3 4 5
16. Regular exercise would take too much of my time 1 2 3 4 5
17. I would have less time for my family and friends if I exercised regularly 1 2 3 4 5
18. At the end of the day, I am too exhausted to exercise 1 2 3 4 5

Appendix O

Godin Leisure Time Exercise Questionnaire

Considering a typical week, how times on average did you do the following kinds of exercise for more than 20 minutes in the last month?

When answering these questions, please remember to:

- Consider a typical (average) week.
- Only count exercise sessions that lasted 20 minutes or longer in duration.
- Only count exercise that was done in your free time (i.e. not occupational or housework).
- Note the differences between the three categories of intensity of activities.

TIMES PER WEEK

a. STRENUOUS EXERCISE ________
(HEART BEATS RAPIDLY, SWEATING)

(e.g., running, jogging, hockey soccer, squash, cross country skiing, judo, inline skating, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, heavy weight training)

b. MODERATE EXERCISE ________
(NOT EXHAUSTING, LIGHT PERSPIRATION)

(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

c. MILD EXERCISE ________
(MINIMAL EFFORT, NO PERSPIRATION)

(e.g., easy walking, yoga, archery, fishing, bowling, shuffleboard, horseshoes, golf, snowmobiling)